
Federal Register

**Friday,**
**August 25, 2006**

## Part II

# Department of Transportation

**Federal Aviation Administration**

**14 CFR Parts 401, 406, 413, et al.**
**Licensing and Safety Requirements for Launch; Final Rule**

**DEPARTMENT OF TRANSPORTATION**

**Federal Aviation Administration**

**14 CFR Parts 401, 406, 413, 415, and 417**

**[Docket No. FAA–2000–7953; Amendment Nos. 401–4, 406–3, 413–7, 415–4 , 417–0]**

**RIN 2120–AG37**

## Licensing and Safety Requirements for Launch

**AGENCY:** Federal Aviation Administration (FAA), DOT.

**ACTION:** Final rule.

**SUMMARY:** This final rule amends commercial space transportation regulations governing the launch of expendable launch vehicles. This action is necessary to codify current launch practices at Federal launch ranges and codify rules for launches from a non-Federal launch site. These safety requirements currently apply to a launch operator through its FAA license. The intended effect of this action is to ensure that the public continues to be protected from the hazards of launch from either a Federal launch range or a non-Federal launch site.

**DATES:** These amendments become effective September 25, 2006. Compliance is required by August 27, 2007.

**FOR FURTHER INFORMATION CONTACT:** René Rey, Licensing and Safety Division, AST–200, Federal Aviation Administration, 800 Independence Avenue, SW., Washington, DC 20591; telephone (202) 267–7538; e-mail *Rene.Rey@faa.gov.* For questions regarding legal interpretation, contact Laura Montgomery, AGC–200, (202) 267–3150; e-mail *laura.montgomery@faa.gov.*

**SUPPLEMENTARY INFORMATION:**

### Availability of Rulemaking Documents

You can get an electronic copy using the Internet by:

(1) Searching the Department of Transportation's electronic Docket Management System (DMS) Web page (*http://dms.dot.gov/search*);

(2) Visiting the FAA's Regulations and Policies Web page at *http://www.faa.gov/regulations_policies/;* or

(3) Accessing the Government Printing Office's Web page at *http://www.gpoaccess.gov/fr/index.html.*

You can also get a copy by sending a request to the Federal Aviation Administration, Office of Rulemaking, ARM–1, 800 Independence Avenue, SW., Washington, DC 20591, or by calling (202) 267–9680. Make sure to identify the amendment number or docket number of this rulemaking.

Anyone is able to search the electronic form of all comments received into any of our dockets by the name of the individual submitting the comment (or signing the comment, if submitted on behalf of an association, business, labor union, etc.). You may review DOT's complete Privacy Act statement in the **Federal Register** published on April 11, 2000 (Volume 65, Number 70; Pages 19477–78) or you may visit *http://dms.dot.gov.*

### Small Business Regulatory Enforcement Fairness Act

The Small Business Regulatory Enforcement Fairness Act (SBREFA) of 1996 requires FAA to comply with small entity requests for information or advice about compliance with statutes and regulations within its jurisdiction. If you are a small entity and you have a question regarding this document, you may contact a local FAA official, or the person listed under **FOR FURTHER INFORMATION CONTACT.** You can find out more about SBREFA on the Internet at *http://www.faa.gov/regulations_policies/rulemaking/sbre_act.*

### Authority for This Rulemaking

The Commercial Space Launch Act of 1984, as codified and amended at 49 U.S.C. Subtitle IX—Commercial Space Transportation, ch. 701, Commercial Space Launch Activities, 49 U.S.C. 70101–70121 (the Act), authorizes the Department of Transportation and thus the FAA, through delegations (64 FR 19586, Apr. 21, 1999), to oversee, license, and regulate commercial launch and reentry activities and the operation of launch and reentry sites as carried out by U.S. citizens or within the United States. 49 U.S.C. 70104, 70105. The Act directs the FAA to exercise this responsibility consistent with public health and safety, safety of property, and the national security and foreign policy interests of the United States. 49 U.S.C. 70105. The FAA is also responsible for encouraging, facilitating and promoting commercial space launches by the private sector. 49 U.S.C. 70103. A 1996 National Space Policy recognizes the Department of Transportation as the lead Federal agency for regulatory guidance regarding commercial space transportation activities. The FAA's authority to issue rules regarding commercial space transportation safety is found under the general rulemaking authority, 49 U.S.C. 322(a), of the Secretary of Transportation to carry out Subtitle IX, Chapter 701, 49 U.S.C. 70101–70121 (Chapter 701).

### Background

This final rule addressing licensing and safety requirements for launch was preceded by two proposals and a draft rule made available to the public through the docket. The FAA published a comprehensive notice of proposed rulemaking (NPRM) on October 25, 2000. 65 FR 63921. The FAA received comments until April 23, 2001. The FAA addressed commenters' concerns in a supplemental notice of proposed rulemaking (SNPRM) published on July 30, 2002. 67 FR 49456 (''2002 SNPRM''). The FAA held a public meeting on the SNPRM on September 6, 2002 and received comments until October 28, 2002. Commenters were concerned with the anticipated cost of complying with the proposal. On February 28, 2005, the FAA placed a series of documents in the docket, including draft regulatory text, a draft analysis of comments (February 2005 Analysis of Comments), a summary of major changes since the SNPRM, and an independent economic assessment from SAIC. 70 FR 9885 (Mar. 1, 2005).

SAIC estimated that the rule would cost the industry a discounted $3.8 million [1] over the years 2005 through 2009. This is less than the $7.3 million discounted cost to industry estimated by this Regulatory Evaluation. SAIC estimated recurring costs ranging from $110,000 to $165,000 per launch and fixed costs of either $0 or $100,000. However, in deriving the total industry cost of $3.8 million (discounted at 7%), SAIC estimated that there would be four to six launches per year. The current FAA launch forecast is about twelve per year. SAIC also estimated and discounted costs over the period 2005 through 2009, while the FAA estimated and discounted costs over the period 2006 through 2010. SAIC costs are in 2002 dollars while FAA estimates are in 2004 dollars.

The FAA converted the SAIC cost estimates to 2004 dollars, used the latest FAA ELV forecast and discounted costs over the five-year period 2006 through 2010. The result was an estimated cost of $10.5 million (discounted to $8.6 million) over the period. This estimate is a conservative one because it uses the higher per launch cost of $165,000.[2] It is also very close to the estimate derived

[1] Using a discount rate of 7%.

[2] We did not estimate a lower range using the lower per launch estimate.

independently in FAA's own Regulatory Evaluation.

The FAA held a public meeting on March 29–30, 2005 and received public comment on these documents until June 1, 2005. The draft analysis of comments in the docket is a detailed analysis of voluminous comments the FAA received during this rulemaking process. The FAA encourages the public to review this analysis of comments for specific concerns regarding this rule. The resolution of those comments is part of the record of this rulemaking.

This final rule codifies the successful safety measures that the Department of Defense and NASA have implemented at Federal launch ranges in the U.S. A launch operator must comply with both FAA commercial space transportation regulations and Federal range launch safety requirements, the latter through its launch license. In addition, some Federal range safety practices are incorporated into vehicle specific documents, also known as ''tailored documents,'' and these practices need to be codified to give all launch operators notice regarding other permissible alternatives. Until this rulemaking, the FAA has not adopted clear safety requirements for launches from a non-Federal launch site. The FAA evaluates applications for launch from a non-Federal launch site on a case-by-case basis, weighing the safety of launches from non-Federal launch sites against Federal launch range practices, procedures and requirements, including the safety requirements of the U.S. Air Force. *See* 14 CFR part 415, subpart F.

This final rule identifies and establishes the requirements for a launch operator launching from a Federal launch range or a non-Federal launch site. This rule allows a launch operator to interact with a Federal launch range in the same manner it does now. This rule also adopts the latest safety practices of Federal ranges, determined through the Common Standards Working Group (CSWG), a joint FAA and Air Force task force. By standardizing safety requirements between the Federal ranges and the FAA, the same level of safety is achieved throughout the United States. This standardization also improves efficiency in the launch industry, because launch operators have one set of clear rules. Codification improves transparency in the regulatory process for both established launch operators and new entrants.

**Summary of the Final Rule**

This final rule establishes requirements for obtaining a license to launch an expendable launch vehicle (ELV) from a non-Federal launch site. This rule also codifies safety responsibilities and requirements that apply to any licensed launch, regardless of where it takes place. The rule prescribes standardized application requirements and clarifies safety issues that an applicant must address. These application requirements, contained in 14 CFR part 415, subpart F, require an applicant to demonstrate how it would satisfy the safety requirements of the new part 417 in order to obtain a launch license.

A launch operator currently supplies a Federal launch range much of the information needed for the various safety analyses and verifications that a Federal launch range performs. However, the Federal launch range staffs and controls the launch. Launch operators will do more of their own safety work at a non-Federal launch site than they have at the Federal launch ranges because they will not be able to take advantage of the Federal range personnel and oversight as they do now. This does not mean that the requirements adopted today are new, only that a launch operator at a non-Federal launch site must work with the FAA to determine how to satisfy the safety requirements normally performed by a Federal launch range.

**Definitions**

The FAA adopts new definitions in this final rule. They include:

*Equivalent level of safety.* The FAA adopts a different definition than was proposed in the 2002 NPRM. An equivalent level of safety now means an approximately equal level of safety as determined by qualitative or quantitative means. The FAA does not adopt its proposed reference to risk in this definition, because demonstration by qualitative or quantitative means need not be risk based. The definition is now broad enough to adapt to new circumstances.

*Launch site safety assessment.* The FAA adopts a definition of a Launch Site Safety Assessment (LSSA), formerly called a baseline assessment. The FAA will assess each Federal launch range and determine if the range meets FAA safety requirements. If there are any differences between range practice and FAA requirements, the differences will be documented in the LSSA. The FAA does not anticipate many, if any, differences for Federal launch ranges because it derived most of the requirements for part 417 from the safety requirements of the Federal launch ranges themselves. A launch operator relying on a LSSA to demonstrate compliance with FAA regulations should pay particular attention to any differences because a launch operator will still be responsible for satisfying FAA safety requirements but may have to perform work or conduct analysis previously performed by a Federal launch range.

**Requirements for Obtaining a Launch License for an Expendable Launch Vehicle**

Part 415 contains requirements that an applicant must meet in order to obtain a license, and part 417 contains requirements that a licensee must comply with during the term of the license. The FAA moved all post-licensing requirements and responsibilities out of part 415 and placed them in part 417, subpart A to group them together. Part 415 references part 417 requirements where appropriate. The FAA did not change its part 415, subpart C application requirements for launching from a Federal launch range, except to clarify the role of a LSSA, and to consolidate and clarify the flight readiness requirements of section 415.37, as discussed in the docketed draft analysis of comments.

**Safety Review and Approval for Launch From a Federal Launch Range**

Subpart C of part 415 describes how the FAA reviews the safety of licensed launches from Federal launch ranges. Subpart C contains safety requirements and recognizes that a launch operator may use a LSSA to demonstrate compliance of FAA safety-related launch services and property provisions.

Section 415.31 explains how the FAA conducts a safety review of an applicant proposing to launch from a Federal launch range. The FAA clarified section 415.31 and other sections in part 417 to make it absolutely clear that an applicant may contract with a Federal range for many Federal range safety-related launch services and property. These provisions should clarify that a launch operator will maintain the same relationship it has with a Federal launch range.

**Safety Review and Approval for Launch From a Non-Federal Launch Site**

Subpart F of part 415 contains requirements that an applicant must meet to obtain a safety approval for a launch from a non-Federal launch site. Subpart F requires an applicant to demonstrate how it would satisfy the safety requirements of part 417 in order to obtain a launch license.

**Launch Safety Generally**

Part 417 contains the standards by which the FAA assesses the adequacy of both a licensee and a Federal launch range. The FAA assesses a launch operator through the licensing process and a Federal launch range through a LSSA. The FAA developed the standards in part 417 after extensive negotiation in the CSWG. These standards include not only current Federal launch range standards but also current practice at the Federal ranges. This rulemaking incorporates any lessons learned through tailoring of launch operator requirements. Therefore, the FAA anticipates that the LSSA for each Federal launch range will disclose few, if any, range differences with part 417 requirements. Nonetheless, it is possible some FAA requirements may differ from range requirements. In such a case, any differences will be documented in a LSSA.

**General and License Terms and Conditions**

The FAA moved existing part 415 subpart E, Post-Licensing Requirements—Launch License Terms and Conditions into subpart A of part 417. This change enables a launch operator to reference one source, instead of two or more for the post-licensing responsibilities and requirements. The requirements of part 417, subpart A apply to launch operators launching from both Federal and non-Federal launch sites, except where noted. As a result, part 415 includes all the responsibilities and requirements that an applicant needs to fulfill in order to obtain a license, and part 417 includes all the responsibilities and requirements that a launch operator needs to fulfill in order to keep a license.

**Requests for Relief and Tailoring**

The Federal ranges permit tailoring of requirements. With tailoring, range and launch operator personnel produce a document that details all areas where the Air Force grants some form of relief without a degradation of safety. The FAA will accept prior agreements between the Air Force and a launch operator, as long as the FAA and the Air Force determine there is no change in circumstance that would degrade safety.

The FAA will utilize equivalent level of safety determinations, similar to the Air Force tailoring process, and FAA waivers to grant relief to launch operators. The FAA will also accept written evidence of Air Force ''meets intent'' certifications (MIC) and previously granted Air Force waivers. The FAA will also accept Air Force grandfathering of prior practices.

**Definition of Public**

This final rule does not change the existing FAA definition of the ''public.'' As discussed in greater detail in the draft final rule in the docket, it is impossible for industry to determine the implications of a change in definition at this time because there has not been opportunity to discuss concerns in depth. Commenters pointed out that a change may impose burdens, place logistical, schedule, and programmatic activities at risk, and adversely impact the cost or availability of insurance. The current FAA definition of public is different from the definition of public that the ranges use. However, recent Federal range safety analysis determined that commercially licensed launches from the Eastern and Western ranges complied with the risk criterion of less than $30 \times 10^{-6}$ when using the FAA definition of the public. In addition, the Western Range has not assessed the impact of the current FAA definition of public for launches of the Evolved Expendable Launch Vehicle scheduled to launch from that range in the near future. The Western Range will conduct a similar safety analysis once the EELV operators provide the appropriate data.

**Launch Services and Liability**

As discussed in the public meeting, the FAA seeks to clarify that a launch operator is responsible for its launches, including launches from a Federal range or from a non-Federal launch site. Even if a launch operator contracts with a Federal range to perform many services, the launch operator must still conduct a launch that complies with part 417. In addition, although a launch operator may contract certain duties and responsibilities required by part 417, the launch operator cannot delegate its accountability for safe operations under part 417.

**Launch Reporting Requirements**

A launch operator is required to provide launch specific information at various times to the FAA after receiving a launch license. All information updates not covered by section 417.17 should be filed under the license modification requirements of section 417.11. The FAA will work with launch operators concerning the availability of information at various points in the launch schedule and the FAA is willing to consider waiver requests for certain reporting requirements.

**Post Launch Report**

This rule requires a launch operator to identify discrepancies or anomalies that occur during the launch countdown or flight, including any deviations from the terms of the launch license or to the operating environments. This rule requires post launch reporting for every launch.

**Launch Safety Responsibilities**

Subpart B of part 417 is a road map describing the responsibilities of a launch operator when conducting a licensed launch of an ELV. Subpart B covers all of the safety issues that a launch operator's safety program needs to address. A launch operator should pay particular attention to section 417.107, because its requirements rely on many of the analyses covered in other subparts. Subpart B contains the requirement to implement the results of analysis, other subparts contain the performance requirements governing those analyses and the appendices include the methodologies to satisfy the performance requirements.

The FAA has clarified in this rule that a launch operator launching from a Federal launch range and contracting with a range for certain safety-related launch services and property may use a LSSA to demonstrate compliance with part 417 requirements. In essence, use of a LSSA preserves the current relationship a launch operator has with a range. If a LSSA finds differences between part 417 requirements and range requirements, the FAA will document any differences in the LSSA, and the FAA and the Air Force will work with a launch operator to resolve these differences.

It is also important to reinforce the change from the FAA's original proposal concerning public risk criteria in paragraph 417.107(b). As discussed in the SNPRM, the FAA originally proposed to aggregate the risks attributable to all mission hazards and set a cap on the total mission risk of all hazards at an expected average casualty of $30 \times 10^{-6}$. The FAA now limits the acceptable risk attributable to each hazard, rather than to an aggregate of the risk for all hazards.

**Flight Safety Analysis**

A flight safety analysis is one of the cornerstones of a safe launch. A flight safety analysis determines where a launch vehicle may safely fly, where it may not, and monitors and controls risk to the public from normal and malfunctioning launch vehicle flight. A launch operator is required to conduct a flight safety analysis by section

417.107(f). Subpart C of part 417 contains the performance requirements for conducting such an analysis. Appendices A, B, C, and I contain the methodologies for meeting the performance requirements of Subpart C.

This final rule does not change current practice between a launch operator and a Federal launch range. A launch operator launching from a Federal launch range may still contract with that range to provide flight safety analyses. Any launch operator contracting with a Federal launch range for flight safety analysis may rely on a LSSA to determine whether the range can ensure compliance with this subpart. That launch operator must ensure that it satisfies any requirement that a range does not meet. The FAA and the Air Force will work with the launch operator to ensure compliance. A launch operator may also file an alternate flight safety analysis for FAA approval.

Under a flight safety analysis the FAA requires a launch operator to use a flight safety system, a wind-weighting safety system for any unguided suborbital launch vehicle, or an alternative flight safety system approved by the FAA during the licensing process. The chart below describes the flight safety analysis requirements for each type of system.

**Requirements for Flight Safety Analysis Depending on Type of System**

| Flight Safety System | Wind-Weighting Safety System | FAA Approved Alternative Flight Safety System |
|---|---|---|
| Trajectory Analysis | Trajectory Analysis | FAA determines requirements during the licensing process. |
| Malfunction Turn Analysis | Not Applicable | |
| Debris Analysis | Debris Analysis | |
| Flight System Safety Analysis | Not Applicable | |
| Straight-up Time Analysis | Not Applicable | |
| Data Loss Flight Time and No Longer Terminate Time Analyses | Not Applicable | |
| Time Delay Analysis | Not Applicable | |
| Flight Hazard Area Analysis | Flight Hazard Area Analysis | |
| Probability of Failure Analysis | Probability of Failure Analysis | |
| Debris Risk Analysis | Debris Risk Analysis | |
| Toxic Release Hazard Analysis | Toxic Release Hazard Analysis | |
| Far-Field Overpressure Effects Analysis | Far-Field Overpressure Effects Analysis | |
| Collision Avoidance Analysis | Collision Avoidance Analysis | |
| Overflight Gate Analysis and Hold and Resume Gate Analysis* | Overflight Gate Analysis and Hold and Resume Gate Analysis* | |
| | Additional Wind-Weighting Analysis** | |

*Only required if a launch flies over a populated or protected area.

** Required by section 417.233.

The performance requirements for a flight safety system and a wind-weighting system are both located in subpart C. However, the methodologies for meeting the performance requirements are different for each system. Appendices A, B, and I contain the methodologies for a flight safety system and Appendices B, C, and I contain the methodologies for a wind-weighting system. All of the following performance requirements adopt current range practices, as identified through FAA consultation with range safety personnel. Below is a description of each of the analyses that together constitute a flight safety analysis. The results of a flight safety analysis using a flight safety system or a wind-weighting safety system are then used to establish rules governing when it is safe to launch, which are referred to as flight commit criteria. A flight safety analysis using a flight safety system also establishes rules governing the termination of flight.

A trajectory analysis establishes, for any time after lift-off, the limits of a launch vehicle's normal flight, as defined by the nominal trajectory and potential three-sigma trajectory dispersions about the nominal trajectory. The trajectory analysis must also establish a fuel exhaustion trajectory and a straight up trajectory. A fuel exhaustion trajectory produces instantaneous impact points with the greatest range for any given time-after-liftoff for any stage that has the potential to impact the Earth and does not burn to propellant depletion before a programmed thrust termination. For example, a stage that fails to terminate at its programmed thrust termination point will continue flight until burnout if the stage contains residual fuel. A straight-up trajectory projects the results that would occur if a launch vehicle malfunctioned and flew in a vertical or near vertical direction above the launch point.

A malfunction turn analysis describes a launch vehicle's turning capability in the event of a malfunction during flight. This analysis accounts for where a vehicle would go in the event of a malfunction by plotting a series of malfunction turns that must account for numerous factors. This analysis determines, for any point in flight, how far off course a vehicle can travel before either the flight safety system takes action or the vehicle breaks apart due to aerodynamic forces.

A debris analysis accounts for the debris produced by both normal events, such as the planned jettison of stages in an ocean, and abnormal events, such as destruction of the launch vehicle. This analysis must identify the inert, explosive and other hazardous launch vehicle debris that results from normal and malfunctioning launch vehicle flight. A debris analysis also requires a debris list, which is commonly referred to as a ''debris model,'' and must account for each cause of launch vehicle breakup. The debris lists describe and account for all debris fragments and their physical characteristics. A debris model categorizes, or groups, debris fragments into classes where the characteristics of the mean fragment in each class represent every fragment in the class. These debris lists are used as input to other flight safety analyses, such as those performed to establish flight safety limits and hazard areas and to determine whether a launch satisfies the public risk criteria of section 417.107.

A flight safety limits analysis identifies when flight must terminate to limit the hazardous effects of debris impacts on any populated or other protected area, establishes designated impact limits to bound the area where debris with a ballistic coefficient of three or more is allowed to impact without a flight safety system failure, and ensures that a launch satisfies the public risk criteria.

A straight-up time analysis accounts for how long a vehicle may fly straight up before it poses a hazard to the public if it fails to turn downrange. This analysis also identifies the point in flight where termination is no longer required. This analysis establishes the latest time after liftoff, assuming a launch vehicle malfunctioned and flew in a vertical or near vertical direction above the launch point, that activation of the launch vehicle's flight termination system or breakup of the launch vehicle would not cause hazardous debris or critical overpressure to affect any populated or other protected area.

Data loss flight time and no longer terminate time analyses establish time periods during the nominal flight of a launch vehicle when flight termination is not necessary even if tracking data is not available. Generally, termination is not required because either the data loss is so brief a vehicle could not reach a populated or protected area or the vehicle has reached a point where the remaining thrusting potential, in a worst case scenario, does not let the vehicle reach a populated or protected area.

A time delay analysis establishes the mean elapsed time between the violation of a flight termination rule and the time it takes a flight safety system to terminate flight. This analysis is used in establishing a vehicle's flight safety limits.

A flight hazard area analysis determines what areas of land, air, and sea must be controlled, by evacuation or notices to mariners and airmen, because of the risk to the public from debris impact hazards. The FAA does not adopt a specific impact probability or casualty expectation protection criterion for ship and aircraft hazard areas because the different federal ranges use different criterion. The FAA simply requires a launch operator to provide the same level of protection as that of a federal range when performing the analysis. The FAA does require a launch operator to conduct a hazard analysis and inform the public as to the location of any resulting hazardous areas. In addition, the FAA provides a methodology in appendix B for quantitatively constructing these hazard areas as part of the hazard analysis using the same construction methods that a federal ranges uses.

A probability of failure analysis requires a launch operator to establish a launch vehicle failure probability, regardless of hazard or phase of flight, in a consistent manner, using accurate data, scientific principles, and a statistically valid method. For a launch vehicle with fewer than two flights, the failure probability estimate must account for the outcome of all previous launches of vehicles developed and launched in similar circumstances. For a launch vehicle with two or more flights, launch vehicle failure probability estimates must account for the outcomes of all previous flights of the vehicle in a statistically valid manner.

A debris risk analysis determines the expected number of casualties ($E_c$) to the collective members of the public, if the public were exposed to inert and explosive debris hazards from the proposed flight of a launch vehicle.

A toxic release hazard analysis determines any potential public hazards from any toxic release during the proposed flight of a launch vehicle or that would occur in the event of a flight mishap. A launch operator performs a toxic release hazard analysis using the methodologies of appendix I of part 417. The FAA requires a toxic release analysis to establish flight commit criteria to protect the public from any toxic release, and to demonstrate compliance with the public risk criterion of section 417.107(b).

A launch operator's flight safety analysis must also establish flight commit criteria that will protect the public from any hazard associated with far field blast overpressure effects due to potential explosions during flight, and to demonstrate compliance with the public risk criterion of section 417.107(b). This analysis applies to any far-field overpressure blast effects analysis such as the potential for overpressure effects based upon meteorological conditions and terrain characteristics, potential for broken windows, launch vehicle explosive capability, population shelter types, window characteristics, and hazard characteristics of glass shards.

A collision avoidance analysis requires a launch operator to establish a period in a planned launch window during which a launch operator could not initiate flight, so as to maintain a 200-kilometer separation from any habitable orbiting object. This analysis must account for all variances associated with launch vehicle performance and timing and ensure that any calculated launch hold incorporates all additional time periods associated with such variances. This standard is in keeping with current practice because a Federal range launch wait already accounts for such variances. A launch vehicle performing nominally within its three-sigma performance envelope could have a different separation distance or intercept time with a resident space object as compared to the same launch vehicle performing on its nominal trajectory. A launch wait, as part of a collision avoidance analysis, accounts for these variances.

An overflight gate analysis determines whether a vehicle can overfly populated areas. This analysis requires a launch operator to file information to explain why it is safe to allow flight through a flight safety limit, the limit that protects populated or protected areas, without terminating a flight. This analysis accounts for the fact that it is potentially more dangerous to populated or protected areas to destroy a malfunctioning vehicle during certain

portions of a launch than not to destroy it. In some circumstances, a destroyed vehicle may disperse debris over a wider area affecting more people than if the vehicle were to impact intact.

A hold and resume gate analysis may, in the event a launch operator has lost tracking data information, still allow a normally performing launch vehicle to overfly or nearly overfly a populated or otherwise protected area to avoid dispersing debris over a populated area when a launch vehicle might still be performing normally. This analysis would expand the range of acceptable trajectories for coastal launch sites whose flight corridors could contain isolated populated or protected islands. It would also increase the availability of inland launch locations by allowing a normally performing vehicle to overfly populated or otherwise protected areas from a site that is wholly contained within a populated or otherwise protected area.

The launch of an unguided suborbital launch vehicle (USLV) flown with a wind weighting safety system also requires analysis to establish wind constraints and other corrections for wind effects on a launch. The flight safety analysis of such a flight must also demonstrate compliance with the safety criteria and operational requirements for the launch of a USLV contained in section 417.125. A launch operator must also ensure the flight safety analysis for a USLV is conducted in accordance with the methodologies in Appendices B, C, and I.

**Flight Safety System**

The FAA also adopts standards for a flight safety system. As discussed earlier, subpart B of part 417 describes when a launch operator must use a flight safety system. Subpart D of part 417 contains the performance requirements of any flight safety system that a launch operator must use. Appendix D has methodologies for meeting the performance requirements of a flight termination system. Appendix E has the test requirements for a flight termination system.

A flight safety system is a system that provides a means of control during flight for preventing a hazard from a launch vehicle, including any payload hazard, from reaching any populated or other protected area in the event of a launch vehicle failure. A flight safety system includes all hardware and software used to protect the public in the event of a launch vehicle failure, and the functions of any flight safety crew. A typical flight safety system is composed of a flight termination system (FTS) and a command control system. The FAA adopts requirements for the flight termination system components onboard a launch vehicle as well as command control components that are typically ground based. This final rule also defines a process for determining the reliability of a flight safety system. The reliability process consists of specific flight termination system design standards and criteria, a reliability analysis of the FTS design, and comprehensive testing to qualify the FTS design and certify and accept FTS components.

A launch operator may employ an alternate flight safety system if approved by the FAA. An alternate flight safety system must undergo analysis and testing that is comparable to that required by Subpart D of part 417 to demonstrate its reliability to perform its intended functions. In addition, the FAA built flexibility into this area by permitting entities, other than a launch operator to conduct required tests or analysis. The FAA recognizes that a vendor, contractor, or Federal range may perform the required tests and analysis of this subpart. However, the FAA notes that a launch operator is ultimately responsible for employing a flight termination system that satisfies all FAA requirements of subpart D and appendices D and E of part 417.

For launch from a non-Federal launch site, compliance with the flight safety system requirements is demonstrated through the licensing process. For a launch from a Federal launch range, the FAA will accept the flight safety system used or approved on a Federal launch range, if a launch operator has contracted with a Federal launch range for the provision of flight safety system services and property, and the FAA has assessed the range through a LSSA and found that the range's property and services satisfy the requirements of this subpart. In this case, the FAA will treat the Federal launch range's flight safety system's property and services as that of a launch operator. This is consistent with the FAA's current practice for launches from Federal ranges. Under this provision, the FAA expects that launch operators at Federal ranges will continue to rely on the Federal range to approve flight termination systems and provide command control and support systems that comply with the requirements of this part.

A flight safety system must have a command control system to transmit a command signal that has the radio frequency characteristics and power needed for receipt of the signal by the flight termination system onboard the launch vehicle. The command control system must include equipment to ensure that an onboard vehicle termination system will receive a transmitted command signal and must meet subpart D's performance requirements, including those addressing reliability prediction, fault tolerance, configuration control, electromagnetic interference, command transmitter failover, the ability to switch between transmitter systems, radio carrier, command control system monitoring, command transmitter system, and command control antennas. Each command control system, subsystem, component, and part that can affect the reliability of a component must have written performance specifications that demonstrate, and contain the details of, how each satisfies the performance requirements of subpart D.

Testing requirements apply to a new or modified command control system. This testing includes preflight testing. Each test must follow a written plan that specifies procedures and test parameters, and must include instructions on how to handle procedural deviations and react to test failures. A launch operator must also prepare written test reports for each test. In accordance with a launch site safety assessment, for a launch from a Federal launch range, a launch operator may continue to rely on the range's verification that the system satisfies all the test requirements. Appendix D of part 417 contains methodologies that a launch operator can use to conduct the tests. Appendix D provides one means of satisfying the requirements of this rule. A launch operator may also file an alternative means for FAA review and approval.

A flight safety system must also have design, test, and functional requirements for systems that support the functions of a flight safety crew, including any determination to terminate a flight. The vehicle tracking system is one of these support systems. It must include two independent tracking sources and provide the launch vehicle position and status to the flight safety crew from liftoff until the vehicle reaches its planned safe flight state. Other support systems include telemetry, a communications network, data processing, display and recording, displays and controls, support equipment calibration, destruct initiator simulator, and timing. The data processing, display and recording system must display and record raw input and processed data at no less than 0.1 second intervals. Again, appendices D and E of part 417 provide the methodologies that a launch operator

must use, absent an equivalent alternative, to conduct the above tests.

This rule also requires a launch operator to demonstrate the predicted reliability of a flight safety system, including a flight termination system, command and control system, and each of its components. This reliability analysis must use a reliability model that is statistically valid and that accurately represents the actual system. These analyses must identify all possible failure points and undesired events, the probability that they would occur, and their effects on system performance. The analyses must demonstrate the reliability of a radio frequency link, any software or firmware, any battery, and the survivability of a flight termination system, when exposed to various hostile environments.

A flight safety system must be operated by a qualified flight safety crew. The flight safety crew's capabilities are verified through a training program and approved during the licensing process. The FAA's training and qualification approach is an adaptation of Federal launch range practices.

**Ground Safety**

The FAA also adopts ground safety standards governing the preparation of a launch vehicle for flight. The FAA recognizes that other Federal agencies regulate various aspects of ground safety. This final rule addresses ground safety issues not otherwise addressed by other Federal regulations, that are unique to space launch processing and that could affect the general public. A launch operator licensee is responsible for developing and implementing a ground safety program in compliance with the specified standards. This final rule does not supersede the ground safety requirements of other regulatory agencies.

In order for a launch operator to meet the ground safety requirements of subpart E of part 417 and the methodologies of appendices I and J, a launch operator must conduct a ground safety analysis. In addition to the Subpart E requirements, a launch operator is also required to conduct a toxic release hazard analysis as part of subpart C, flight safety analysis. For a launch from a range, a launch operator may rely on a launch site safety assessment to demonstrate compliance with both the ground safety analysis and the toxic release analysis. In addition, a launch operator may also demonstrate the acceptability of an alternative method of compliance.

A ground safety analysis consists of identifying each potential hazard, each associated cause, and each hazard control that a launch operator must establish and maintain to keep each identified hazard from affecting the public. A launch operator not relying on a LSSA must conduct this analysis for launch vehicle hardware, ground hardware (including launch site and ground support equipment), launch processing, and post-launch operations. A launch operator not relying on a LSSA must record all of this analysis in a ground safety report, the format for which is located in appendix J.

A launch operator must classify each hazard in the analysis described above as a public hazard, a launch location hazard, an employee hazard, or a non-credible hazard. For some hazards capable of creating catastrophic consequences, a launch operator must implement a dual fault system, so that no single act could cause the catastrophic event. Once a hazard is identified, classified, and a corresponding control is in place, a launch operator must also conduct periodic inspections to ensure safety devices and hazard controls remain in working order. A launch operator must also establish a safety clear zone and prohibit public access during hazardous operations.

**Discussion of Comments**

At the conclusion of the public comment period on June 1, 2005 the FAA received written comments from The Boeing Company, Lockheed Martin Corp., NASA, Orbital Sciences Corp., Sea Launch Company, Space Exploration Technologies, XCOR Aerospace, and three comments from private citizens. The following discussion responds to substantive comments that explain the reasons for the comment and that were not already submitted and responded to in the past.

**General Comments**

A number of comments repeat suggested changes for several sections. We address these comments here, instead of in every section. First, for several sections commenters suggested repeating the FAA's willingness to accept alternative approaches that provide an equivalent level of safety.[3] However, it is better to state this only once at the beginning of each subpart, so that a finding of an equivalent level of safety may be made for any requirement in a subpart, rather than just in a few select sections.

Second, if a comment submitted in 2005 repeats a comment submitted in response to earlier notices, but raises no new issues or adds no new information, the FAA will continue to rely on its own earlier response, including those placed in the docket on February 28, 2005. For example, XCOR Aerospace, in addition to providing new comments, also submitted a copy of the same comments given in response to the 2001 NPRM.[4]

Third, the FAA is unable to respond to comments that do not provide an explanation or a reason for a suggested change for a comment.[5] Likewise, a number of comments request a change to the proposal based on cost concerns, but do not provide cost data to substantiate that concern.[6] In addition, we do not specifically address requests for clarifying or editorial changes, even though we may accept some of those changes.[7]

Fourth, some commenters continue to suggest that they do not satisfy the part 417 requirements or they are currently operating to a different standard. This is because a range found an equivalent level of safety through tailoring or a meets intent certification. The FAA's grandfathering policies should address these concerns. Also, as noted in the Analysis of Comments the FAA placed in the docket on February 28, 2005, the FAA did consult with the ranges regarding a number of these concerns when they were raised earlier in the rulemaking, and operators are

[3] *See* Lockheed comments concerning sections 417.1(c), D417.1(a) E417.1(a).

[4] *See also*, Lockheed comments concerning sections 417.1(g), 417.105(a) and (b), 417.111(d)(4), 417.231(a), 417.303(c), 417.303(d), 417.307(b)(8), 417.307(h)(4), 417.309(b)(2), 417.309(c)(4), 417.309(j), 417.407(a), 417.407(b), 417.417(b), D417.5(c)(3), D417.13(c), D417.17(b)(6), D417.29(b)(2)(ii), D417.33(d), D417.33(g)(6), D417.31(h), D417.31 (i), E417.1(d)(3), Lockheed proposed E417.1(j), E417.3(f)(3), E417.11(g)(1), E417.19(e)(2)(ii), E417.19(e)(2)(vi), E417.25(f)(2), E417.29(b)(6); Boeing's comments concerning sections D417.41(c), D417.45(m), D417.47(b), E417.1(d)(3).

[5] *See* Lockheed comments concerning sections 417.3, 417.107(f), 417.111(e)(2), 417.207(b), 417.303(l)(6), D417.3(b), D417.21(a), E417.9(l), E417.19(d), E417.25(c)(2), E417.25(i), E417.25(j)(4); Boeing comments concerning D417.7(l), E417.15(b), E417.21(b)(iii), E417.25(c)(2), E417.25(i), E417.35(b).

[6] *See* Lockheed comments concerning sections 417.1(f), E417.35(c).

[7] *See* Lockheed comments concerning sections 417.11(c)(2)(ii), 417.301(c)(1), 417.307(b)(4), 417.307(e)(2), 417.3079(e)(7), 417.307(f)(8), 417.309(b), 417.309(c), 417.309(f)(3)(i), 417.311(b)(2), 417.402(e), 417.403(c), 417.405(e), 417.405(f), 417.405(g)(3), 417.405(j)(5), D417.5(i), D417.9(b) & (d), D417.21(e), D417.25(b), D417.29(a)(1), D417.29(b)(1)(i), D417.33(h)(2), E417.1(g), E417.5(g)(3), E417.7(d), E417.9(a), (b), and (e), E417.11(f)(2), E417.11(h)(1), E417.19(d)(1), E417.19(d)(5), E417.9(e)(1); Boeing comment concerning B417.13.

apparently in compliance, but unaware that they are.[8]

Fifth, the FAA received several comments concerning requirements for a launch operator to file information during a particular time period, *e.g.*, thirty days before a launch. The FAA did not change the suggested timing requirement because the FAA already provides a process for granting waivers under part 404. As noted at the 2005 public meeting, the FAA routinely grants waivers to administrative timing requirements. Additionally, the FAA plans to permit the coordination of timing issues at Federal launch ranges to be taken care of by the Federal launch ranges.[9]

Sixth, the FAA received some comments claiming that a proposed requirement was not current practice. The FAA reviewed current practice with the Federal launch ranges, and received confirmation that the commenters suggestion is current practice at the ranges. The FAA therefore adopts the commenters suggestions.[10] In addition, some comments simply claimed that a proposed requirement is not current practice, without further explaining what the commenter considers current practice.[11] The FAA was able to confirm with the Federal ranges that the FAA requirement is current practice. In this regard, commenters who questioned whether a requirement was current practice in this latest round of comments may be assured that the FAA checked again with U.S. Air Force range safety personnel on each comment discussed in detail below.

Finally, XCOR submitted general comments concerning the latest draft documents placed in the docket on February 28, 2005. These comments included the general statement that the FAA should abandon this rulemaking, start over, and engage industry in real dialogue because this rulemaking will destroy industry, is too burdensome, and actually decreases public safety. The FAA notes that this rulemaking adopts current practice, so there is no degradation to public safety. In addition, the industry's relationship with the Federal launch ranges will not change. To the extent that XCOR is concerned that current practice is too burdensome, the FAA is not proposing any changes.

**Launch Site Safety Assessments**

In accordance with comments from industry, if the FAA has assessed a Federal launch range, through its launch site safety assessment, and found that an applicable range safety-related launch service or property satisfies FAA requirements, then the FAA will treat the Federal launch range's launch service or property as that of a launch operator's, and there will be no need for further demonstration of compliance to the FAA. The FAA agrees with most commenters that existing Federal launch range safety requirements and processes have worked well in protecting the safety of the public and property. The March 2005 Draft Regulatory Language and Analysis of Comments, at 106, stated that the FAA had assessed the Federal launch ranges through the FAA's launch site safety assessment, and found that applicable range safety-related launch analyses, services or property satisfied the requirements. Therefore, the FAA proposal intended to treat a Federal launch range's launch service or property as that of a launch operator's. The FAA remains committed to this position. Participants at the 2005 public meeting referred to this practice as an ''off-ramp.''

The FAA discussed the sufficiency of the launch site assessment process at a public meeting held on March 29–30, 2005 (''2005 public meeting''). At that public meeting, FAA officials thoroughly briefed, discussed, and entertained multiple questions from industry representatives in an attempt to assure the launch operators of the FAA's plan to allow launch operators to continue using the ranges as their primary interface. The FAA encouraged the launch operators to work with the FAA in determining appropriate language if the proposed language did not satisfy industry concerns. Industry was encouraged to act immediately and not wait until the end of the comment period. Industry responded at the close of the comment period.

Orbital[12] described the FAA's previously established approach to accepting a Federal launch range's range safety-related launch service or property as an ''off-ramp'' for launch operators operating on a Federal launch range. Orbital requested that the FAA expressly provide that no further demonstration of compliance to the FAA be required of a launch operator, and the FAA adopts this clarification. Lockheed suggested similar language for section 417.1(g). The FAA provides this assurance at the beginning of every substantive subpart of this rule.

Boeing suggested removing any suggestion that a Federal launch range's analyses might not satisfy an FAA requirement, and that the provision should not entertain that possibility. The FAA does not accept this suggestion. Federal launch range practices change over time. Ideally, the FAA's launch site safety assessment reflects those changes. However, a Federal launch range could change a requirement without the agreement of the FAA. This is highly unlikely due to the CSWG goal of maintaining common standards. A Federal launch range could, however, decide that it no longer will perform a flight safety analysis or some other service for launch operators due to a decreasing budget or other reasons. Therefore, the FAA's acceptance of Federal launch range work must recognize that theoretical possibility.

**Application Requirements**

Section 415.111 requires that an applicant's safety review document identify all persons with whom the applicant has contracted to provide goods or services for the launch of the launch vehicle. Sea Launch commented that this is an overly detailed requirement and it would be nearly impossible to meet because it includes all persons with whom the applicant has contracted. Sea Launch recommends that the requirement be limited to only persons who provide safety-related services. The FAA agrees

[8] *See, e.g.*, Boeing comments concerning sections 417.209(a)(6), A417.7(2)(g)(1), D417.5(c), D417.7(c)(1), D417.7(c)(4), D417.7(g)(1)(i), D417.13(c), D417.15(b)(1), D417.35(d), D417.45(b) and (o), D417.47(i), E417.33(c), E417.41(e)(1); Lockheed comments concerning sections 417.301(d)(2), D417.7(g)(1)(i), D417.19(g)(2), D417.27(h), D417.29(b)(9), D417.53 (d), E417.9(j), E417.11 (b)(3), E417.11(c)(2), E417.11(c)(3), E417.11(c)(6), E417.11(e)(2), E417.11(e)(4), E417.11 (h)(1)(ii), E417.11 (h)(4)(ii), E417.11(i)(2)(ii), E417.13(d)(2)(v), E417.13(e)(1)(i), E417.13(e)(2)(ii), Table E417.17–2, Table E417.19–1, E417.19(e)(2)(i), E417.19(e)(2)(v)(A), E417.19 (e)(2)(xiii), E417.19(f)(2), E417.19(f)(10), E417.19(f)(11), all Lockheed comments concerning section E417.19(j), E417.21(b)(iv), E417.21 (g)(2), E417.21(j)(4)(i), (j)(4)(ii) E417.21(p)(1), E417.21(p)(3)(ii), E417.21(q)(6), E417.21(r)(5), E417.22(a), E417.25(g)(4), E417.25(h), E417.31(b)(4), E417.33(c), E417.37(b)(2), E417.41(h)(1)(ii), E417.41(h)(2)(i)(1)(i), E417.41(h)(2)(i)(1)(iii), E417.41(h)(2)(i)(5)(i), E417.41(h)(2)(i)(6).

[9] *See* Boeing comments concerning sections 417.117(b)(2), E417.41(e)(1); Lockheed comments concerning sections 417.17(c)(4), 417.17(c)(7), E417.41(d)(2), E417.41(e)(1), E417.41(h)(2), E417.41(h)(2)(i), E417.41(h)(2)(i)(1)(v), E417.41(h)(2)(i)(2)(i), E417.41(h)(2)(i)(3), and Sea Launch comments concerning sections 415.115 and 415.121.

[10] *See* Lockheed comments concerning sections 417.9(c), E417.3(e)(1), E417.11(b)(4)(iii).

[11] *See* Lockheed comments concerning sections 417.303(b), 417.307(a)(2), 417.309(c)(6), D417.5(e), D417.7(c)(6), D417.19(e), E417.5(g), E417.7 (f)(5), E417.25(f)(4).

[12] *See also*, Boeing, at 1, and Lockheed, subpart A at 1–2, 7–9, subpart B at 1–2, 4–6, 8–13, subpart C at 1–2, subpart D at 1–3, subpart E at 1–4, 7–9, Appendix A at 1, Appendix B at 1, Appendix D at 2–3, Appendix E at 1–2, Appendix G at 1, Appendix I at 1, Appendix J at 1, also commented on the off-ramp process.

and adopts the requirement as suggested.

Section 415.123 contains requirements for computing systems and software. Sea Launch commented that these requirements are not current practice. AFSPCMAN 91–710, Volume 1, Attachment 2 , ''System Safety Program Requirements,'' requires analysis of software and computing systems hazards and risks as part of a comprehensive analysis of system safety, and verification and validation. Therefore, the FAA did not change this section in response to this comment.

**Launch Safety**

*Requests for Relief*

Paragraphs (c) and (d) of section 417.1 require written evidence of a meets intent certification or waiver for a launch operator to be eligible for relief. Lockheed and Boeing commented at the 2005 public meeting that such evidence may not exist in the way of a meets intent certification. The FAA clarifies that other forms of written evidence are acceptable and now provides examples

Section 417.1(c) provides a launch operator with an alternative means to satisfy an FAA requirement through an equivalent level of safety if written evidence demonstrates that a Federal launch range has, by the effective date of this part, granted a ''meets intent certification.'' Section 417.1(d) states that a requirement of this part does not apply to a launch if written evidence demonstrates that a Federal launch range has, by the effective date of this part, granted a waiver that allows noncompliance with the requirement. Lockheed requested the FAA strike the term, ''by the effective date of this part.'' Lockheed stated that suspension of the ''meets intent'' certification process and waiver process as of the effective date of the final rule promulgated by the FAA would result in a significant impact to the Atlas program, although Lockheed did not state in its written comments how or why this impact might occur.

As discussed in the 2005 public meeting, the FAA cannot eliminate the reference to the effective date. This effective date is retained because any relief granted before the effective date requires proof that the Federal launch range granted such relief. After the effective date, the FAA will coordinate with the Federal launch range to determine whether relief should be granted. Also, as discussed in the SNPRM, agencies cannot waive each other's requirements. This rulemaking remedies that problem. The effective date requirement must remain because the requirement applies to all previously grandfathered requirements. The effective date does not terminate the relief process, as suggested by Lockheed and Boeing.

Lockheed Martin also suggested that the FAA add a new section adopting the practice of ''tailoring'' at the Federal ranges. The FAA does not need to add the section because although the FAA in practice will continue the tailoring process, it will do so through the use of an equivalent level of safety determination.

*License Terms and Conditions*

Section 417.7 states that a launch operator is responsible for ensuring public safety and the safety of property at all times during the conduct of a licensed launch. Lockheed requested the FAA add that for licensed launches from a Federal launch range, compliance with section 417.13, which says a launch operator must enter into an agreement with and comply with range requirements, satisfies the launch operator's public safety requirements. Lockheed reasoned that the Federal launch ranges play a key role in conducting launch activities and the range has its own authorities and responsibility with regard to ensuring public safety. A launch operator cannot subsume these responsibilities. Although Lockheed is correct about the important role of the Federal launch ranges, the role of the range does not detract from a launch operator's responsibilities for safety under its license. A Federal launch range cannot subsume a launch operator's responsibilities either. The FAA's description of the launch operator's responsibility has been part of the regulations for years. *See* 14 CFR 415.71. That a range has responsibilities does not mean that a launch operator does not have these same responsibilities. As explained in previous rulemakings, a launch operator must comply with the requirements of both the ranges and the FAA. *See, Commercial Space Transportation Licensing Regulations, NPRM*, 62 FR 13234 (Mar. 19, 1997).

**Scheduling**

Proposed section 417.17(b)(1) would have required that for each launch, a launch operator must file a launch schedule that identified each point of contact by name and position for each scheduled activity. The FAA proposed that the points of contact be filed no later than six months before flight. Sea Launch commented at the 2005 public meeting and both Boeing and Sea Launch commented in written comments, that a single schedule point of contact is current practice and that requiring the information six months before flight was excessive. The FAA agrees and instead requires a single point of contact for the schedule and that the launch schedule must be filed and updated in time to allow FAA personnel to participate in the reviews, rehearsals, and safety critical launch processing.

Proposed paragraph (b) of section 417.25 would have required that for a launch operator launching from a non-Federal launch site, a launch operator must file a post launch report with the FAA 90 days after the launch. Sea Launch commented that current practice requires a 30 and 60 day report and that the 90 day report is not current practice. The reports filed by Sea Launch under current practice meet the requirement of section 417.25(b). To clarify, the FAA now requires the report be filed no later than 90 days after launch. The clarification is also made to section 417.25(a).

**Launch Safety Responsibilities**

Section 417.103(b)(2) requires that a safety official have direct access to a launch operator's launch director. The FAA had proposed that a safety official report directly to the launch director, but Lockheed pointed out that these employees may be stationed in different parts of the country. The FAA clarifies that direct access means a safety official can communicate safety concerns to the launch director. This provision does not mandate the organizational structure of a launch operator.

*Flight Safety*

Section 417.107(b) requires a launch operator to demonstrate that any risk to the public satisfies public risk criteria of $E_c \leq 30 \times 10^{-6}$ for each hazard before initiating the flight of a launch vehicle. Boeing suggested that the FAA use $30 \times 10^{-6}$ as a level defining acceptable launch risk without high management review. As it has in the past, Boeing suggested that the $E_c$ criterion lacks mathematical justification and therefore should not represent a hard limit. The acceptable risk criterion for debris at $30 \times 10^{-6}$ is current practice and has been an FAA requirement since 1999 under section 415.35(a), which is not changed by this rulemaking. Previous FAA discussions in the July 2002 SNPRM, the February 2005 Analysis of Comments, and the FAA's 2005 public meeting discussed the $30 \times 10^{-6}$ criterion and its acceptability.

Section 417.107(e) requires a launch operator to ensure that a launch vehicle, any jettisoned components, and its payload do not pass any closer than 200

kilometer to a habitable orbital object and to obtain a collision avoidance analysis for each launch. Lockheed [13] requested that the FAA change ''habitable'' to ''known inhabitable'' on the grounds that if there is uncertainty about whether an object is habitable the required collision avoidance distance may be less. The FAA will not adopt the suggested change because it would not change the separation distance or reflect current practice in classification of these types of orbital objects. Even if an object is not known to be habitable with absolute certainty, safety errs on the side of being conservative and claims of habitability are taken at face value. If an object is designed to be habitable the separation distances must be maintained.

Instead, the FAA requires a 200 km separation distance for ''manned or mannable'' objects to match the current terminology of the Federal launch ranges in AFSCMAN 91–710 and the United States Strategic Command. Mannable objects include all orbital objects that are designed for manned spaceflight. Habitable, or mannable, objects are known and the FAA requirement only applies to those known objects and not to all resident space objects. Current manned or mannable objects include the Space Transportation System (STS), International Space Station (ISS), and Chinese Shenzou spacecraft. The FAA can adjust the miss distance through an equivalent level of safety on a case-by-case basis similar to Federal launch range current practice.

Section 417.111(e)(2) and (g)(4) require a launch operator to identify personnel, by position, who have authority to approve design changes, maintain documentation of the most current approved design and conduct piece parts tests. Lockheed Martin objected to these requirements on the grounds that a launch operator is responsible for design changes, the requirement might conflict with other hiring, certification and qualification requirements (although Lockheed does not describe the conflicts), and with a launch operator's ability to make personnel decisions. Because the FAA only requires that a launch operator identify such positions, the FAA does not believe that these concerns are well founded. To the contrary, for purposes of configuration management and control, a launch operator should know which position is responsible for design changes, document control and conducting piece parts tests as a matter of prudent business practice.

Section 417.111(h)(2) requires that an accident investigation plan (AIP) contain procedures that ensure the containment and minimization of the consequences of a launch accident, launch incident or other mishap. Boeing comments that this type of procedure is usually in an accident response plan not an accident investigation plan because different personnel perform these tasks. The FAA disagrees because this requirement is consistent with existing FAA regulations as found in 14 CFR 415.41(d), 420.59(c), and 431.45(c).

Sea Launch, commenting on sections 417.117(b)(1) and 417.121(a), recommends against requiring a launch operator to review its hazardous operations or identify safety critical pre-flight operations. Because of its unique circumstances, these requirements do not apply to Sea Launch. The FAA does not regulate launch processing operations on the ground outside of the United States. Chapter 701 of Subtitle IX, defines launch to include ''* * * activities involved in the preparation of a launch vehicle * * * for launch, when those activities take place at a launch site in the United States.'' 49 U.S.C. 70102(4). The launch processing requirements do not apply to Sea Launch because its preparatory activities take place at a launch site outside the U.S. To some extent the comments address flight safety. Sea Launch claims that identifying safety critical preflight operations in a launch schedule is too detailed, and that the FAA has always been informed when such an operation occurred. The FAA agrees that under current practice Sea Launch keeps the FAA informed of safety critical pre-flight operations, but notes that to be informed of them, they must be identified. The FAA and Sea Launch work closely through e-mail and phone contact to identify schedule updates as safety critical preflight operations change. Sea Launch provides a weekly schedule to the FAA via e-mail and also responds immediately to all FAA phone requests for status on safety critical preflight operations. This process has worked well in the past and the FAA recommends that Sea Launch continue this process of notifying the FAA of schedule changes. However, the FAA believes identifying safety critical preflight operations in a launch schedule is critical to maintaining the current level of safety and adopts the requirement.

**Rehearsals**

Section 417.119(a)(3) would have required each person with a public safety critical role who will participate in the launch processing or flight of a launch vehicle to participate in at least one related rehearsal that exercises all that person's functions. Sea Launch agreed that personnel must rehearse, but stated it would be impossible to exercise all the functions of a public safety critical role in a rehearsal. The FAA does not agree with Sea Launch's proposal that personnel should only participate actively in one related rehearsal, because a single rehearsal does not necessarily exercise personnel in all disciplines of responsibility. Some rehearsals include deliberate anomalous inputs while others exercise normal countdown flow. Personnel may have to participate in more than one rehearsal to exercise their functions. The FAA does agree, however, that it could be impossible to exercise all the functions of a public safety critical role. Therefore, section 417.119(a)(3) requires that each person with a public safety critical role who will participate in the launch processing or flight of a launch vehicle must participate in at least one related rehearsal that exercises his or her role during nominal and non-nominal conditions so that the launch vehicle will not harm the public.

Section 417.119(c) requires a launch operator to conduct a rehearsal of the emergency response section of the accident investigation plan for a first launch of a new vehicle, for any additional launch that involves a new safety hazard, or for any launch where more than a year has passed since the last rehearsal. Sea Launch stated this requirement was not current practice. This requirement does not apply to Sea Launch until such time as it launches a new vehicle, identifies a new safety hazard, or more than a year has passed since the last rehearsal. The FAA currently accepts the rehearsal methodology employed by Sea Launch.

Section 417.119(d) requires a launch operator to rehearse each part of the communications plan required by section 417.111(k), either as part of another rehearsal or during a communications rehearsal. Sea Launch stated these requirements are not current practice and are impractical. Each launch operator will have different plans. The FAA agrees that each launch operator has a different communications plan, but each launch operator must rehearse each part of its communications plan to validate every part of the communications plan. The differences matter only if they do not

[13] *See also*, Lockheed comments regarding §§ 417.3, 417.107(e)(1), 417.107(e)(1)(ii)(B), 417.231(b), (c), and (d), A417.31(a)(3), A417.31(c)(7)(iv), A417.31(c)(8), A417.31(c)(8)(i).

satisfy the requirements. The FAA currently accepts Sea Launch's communications training sessions.

**Flight Safety Analysis**

*Malfunction Turn Analysis*

Section 417.209 requires that a flight safety analysis include a malfunction turn analysis that establishes the launch vehicle's turning capability in the event of a malfunction during flight. Section 417.209(a)(6) requires the turning behavior from the time when a malfunction begins to cause a turn until aerodynamic breakup, inertial breakup, or ground impact. The analysis must contain trajectory time intervals, during the malfunction turn, that are sufficient to establish turn curves that are smooth and continuous.

Boeing needed to confirm with the FAA that its current practice provided an equivalent level of safety. The Federal launch ranges at the Eastern Range and Western Range have accepted the current Boeing practice and find that the data provided allows them to conduct their safety analyses in a manner that satisfies the Federal launch range requirements. The Federal launch range and the FAA have common requirements in this area and both of these ranges have an FAA approved launch site safety assessment. Therefore, the FAA accepts this equivalent level of safety as one that satisfies the FAA requirement.

**Flight Safety System**

Lockheed requested that in the event of a vehicle failure, a flight termination system (FTS) prevent exceeding a casualty expectation, instead of preventing a vehicle hazard from reaching a populated or otherwise protected area. The FAA does not accept this recommendation because it is current practice to require use of an FTS to prevent a vehicle from reaching vulnerable areas and to prevent a low probability, high consequence event. Risk criteria are separate from the safety requirements for a flight termination system and are not interchangeable.

For section 417.303(l)(1), Lockheed inquired whether the requirement for two or more command signals, which are signals to destroy a vehicle, requires at least two antennas. This rule requires two or more command signals, which requirement is a performance standard that only requires the launch operator to use at least two command destruct signals. The method of compliance is up to the launch operator. Redundant antennas may be used to meet this requirement.

Lockheed suggested that section 417.303(l)(2)(iii) should require each antenna beam width to extend out to the boundaries of ''the destruct limit lines'' instead of ''normal flight'' as the FAA proposed. The FAA did not accept the suggestion because the boundaries of normal flight could extend beyond the destruct lines. Normal flight is not necessarily along the nominal path.

Section 417.305(a)(1) requires a command control system, including its subsystems and components, to undergo performance testing when new or modified. Lockheed commented that it is unclear how ''modified'' is defined, and suggested the FAA specify the level of change that triggers the need for acceptance testing. A command control system component will undergo performance testing at acceptance level environments after completion of the manufacturing processes. The extent of the modification for a particular system will determine the amount of additional retesting that will be required. Extensive modifications to the component may require full or limited performance testing at qualification environments using the qualification test article. In such a case, after successful performance testing of the qualification unit, the flight units subjected to acceptance testing under pre-modification test requirements and environments may require full or limited acceptance testing. In some cases, there may be no additional performance testing at either qualification or acceptance environments. There are modifications that are so minor as to avoid the need for new performance testing. The qualification test for the original systems sets the bar for retesting changes. If the change falls within the qualification envelope of the original system, the operator need not retest the system. A qualification of the modified system by similarity to the original system is also acceptable.

The FAA cannot specify a single level of modification that triggers retesting because the level may differ from system to system. The FAA will determine post modification testing requirements jointly with the Air Force and the launch operator.

For section 417.305(d), Lockheed suggested that a launch operator not be required to obtain a range's verification that a command control system satisfies all test requirements. The FAA agrees that for launches from a Federal range where the range provides and tests the command and control system, the FAA will assess this process in the LSSA and the launch operator will not have to obtain the verification.

*Support Systems*

Section 417.307 contains design, test, and functional requirements that apply to those systems that are required to be part of a flight safety system to support the functions of a flight safety crew, including making a flight termination decision.

Section 417.307(b)(1) requires a launch vehicle tracking system that provides launch vehicle position and status data to the flight safety crew from the first data loss flight time until the planned safe flight state for launch. Lockheed questioned the meaning of ''first data loss flight time,'' and asked whether it was the same as ''time to endanger.'' ''First data loss flight time'' is simply the first flight time associated with a loss in data. This equates with the time at which the Federal launch range's ''green numbers'' or ''critical time'' would begin counting down. ''First data loss flight time'' has the same meaning as ''time to endanger.''

Proposed section 417.307(b)(2) would have required that a tracking system consist of two sources of launch vehicle position data. Lockheed recommended allowing more than two tracking sources. The FAA agrees that more than two tracking sources may be used. This rule only states what is required, and an operator may use more than two tracking sources if it desires. The requirement does not limit the number of tracking sources to two.

Section 417.307(b)(6) requires that each tracking source undergo validation of its accuracy for each launch. Paragraph (b)(6) also requires that for each stage of flight that a launch vehicle guidance system be used as a tracking source. A tracking source that is independent of any system used to aid the guidance system must validate the guidance system data before the data is used in the flight termination decision process. Lockheed recommended against requiring that a tracking source be validated for each stage of flight. The FAA does not accept the recommendation because validation of guidance system data during one stage of flight does not necessarily validate it for any subsequent stages of flight. A shock event, such as staging, can affect the accuracy of guidance system data.

Proposed section 417.307(e)(5) would have required that a flight safety data processing, display, and recording system both display and record raw input and processed data at a rate that maintains the validity of the data and at no less than 0.1-second intervals. Lockheed recommended against requiring intervals of 0.1-second. The FAA did not change this standard

because it is current practice. However, the FAA expects that some systems may be granted an equivalent level of safety determination that allows a sample rate of more than 0.1-second.

Section 417.307(h)(1) requires a destruct initiator simulator to have electrical and operational characteristics matching those of the actual destruct initiator. Lockheed recommended replacing characteristics with a performance margin. Lockheed says that it is not practical to fire live ordnance and, under current practice, the simulators exceed the requirement. The FAA disagrees and adopts section 417.307(h)(1) as proposed because live fire is not required. Simulation is allowed. In addition, a simulator that exceeds the actual destruct initiator or that demonstrates a performance margin, as Lockheed suggested, meets this requirement.

*Flight Safety System Analysis*

Section 417.309, contains requirements for the system analyses that would apply to the design of a flight termination system and a command control system, including their components. Proposed section 417.309(a)(2) would have required that a flight safety system analysis follow a standard industry system safety and reliability analysis methodology. Sea Launch requested that, because a U.S. standard may not apply globally, the FAA require an analysis to follow an approved FAA system safety and reliability analysis or an equivalent methodology. The FAA agrees and will assess a methodology against the performance requirements of this section.

Section 417.309(c)(1) requires a command control system to undergo an analysis that demonstrates that the system satisfies fault tolerance requirements by following a standard industry methodology such as a fault tree analysis or a failure modes effects and criticality analysis. Lockheed suggested adding fishbone analysis to the list of examples. The FAA agrees that fishbone analysis can be used to satisfy this requirement, but the example list is not intended to be all inclusive.

Section 417.309(f)(1) requires each flight termination system and command control system to undergo a radio frequency link analysis to demonstrate that each system satisfies the required margins. Lockheed recommends clarifying that the margin is for the flight safety system, not individual segments of the system. The FAA agrees and adopts the recommendation.

Section 417.309(j)(3) requires that a flight termination system undergo an analysis that demonstrates that each subsystem and component, including their location on the launch vehicle, provide for the flight termination system to complete all its required functions when exposed to launch vehicle staging, ignition, or any other normal or abnormal event that, when it occurs, could damage flight termination system hardware or inhibit the functionality of any subsystem or component, including any inadvertent separation destruct system. Lockheed suggested tying breakup survival requirements to the shock requirements of section D417.7(g). The FAA does not adopt the suggested change because the breakup environment should include more than just shock.

Proposed section 417.311 (b)(1) would have required that all safety crew members have knowledge of systems and operations. Lockheed commented that not all safety crew members have knowledge of all systems and operations. The safety crew as a whole has the required knowledge but individual safety crew members may not be familiar with all systems and operations. The FAA agrees and has clarified that the safety crew as a whole must have knowledge of systems and operations.

**Ground Safety**

Section 417.405(b) contains the qualification requirements for personnel who prepare a ground safety analysis. Lockheed commented that the proposed experience and training requirements were too stringent. The FAA agrees and the requirements for education, training, and experience are instead adopted as a performance requirement. The FAA believes the individual who performs the ground safety analysis must possess background and experience qualifications in the engineering disciplines associated with launch vehicle ground operations, ground processing hazards, and the precautions required to prevent mishaps.

Lockheed suggested basing safety clear zones on the ''credible effects'' for a possible explosive event for section 417.411(a)(1)(i) and for a possible toxic event for section 417.411(a)(1)(ii), instead of basing each safety clear zone on a worst case scenario. The FAA does not adopt this suggestion because public safety and current range practice require use of the worst case standard. In addition, it is unclear what ''credible effects'' include.

Section 417.415(b)(3) requires a launch operator to establish procedures for controlling hazards associated with a failed flight attempt where a start command was sent to a solid- or liquid-fueled launch vehicle, but the launch vehicle did not liftoff. These procedures must include prohibiting individuals' entry into the launch complex until the launch pad area safing procedures are complete. Lockheed comments that the range permits pad entry on a case-by-case basis. The FAA clarifies that this requirement is intended to prevent entry by the public into the launch complex during a failed attempt. The FAA further clarifies that this requirement does not apply to launch operator personnel.

**Flight Safety Analyses Methodologies and Products for a Launch Vehicle Flown With a Flight Safety System**

*Trajectory*

For section A417.7, Boeing suggested the FAA allow a launch operator to define the longitude as positive degrees East or positive degrees West without requiring a specific reference. In response, the FAA will not adopt the proposed specification on the geodetic longitude reference. Section A417.7 corresponds to current requirements at the Federal launch ranges as documented in AFSPCM 91–710, Tables A1.1 through A1.4.

*Debris*

Section A417.11(b) requires that a debris analysis produce a debris model that accounts for all launch vehicle debris fragments, individually or in groupings. Section A417.11(b)(3) requires a description of the immediate post-breakup or jettison environment of the launch vehicle debris, and any change in debris characteristics over time from launch vehicle breakup or jettison until debris impact. Boeing stated the FAA should encourage one set of simplified ''worst-case'' estimates of debris characteristics applicable over time. Simplified estimates should be acceptable as long as they were conservative, according to Boeing. Boeing made similar comments regarding sections A417.11(c)(7), A417.11(c)(8), A417.11(d)(5) and A417.11(d)(17). Section 417.211 contains the performance requirement for a debris analysis. Section 417.211 responded to earlier industry comments for a more performance-based requirement. Appendix A provides one suggested method of meeting the performance requirement. A launch operator's analysis may always be more conservative as long as the final analysis meets the public risk criteria of section 417.107(b).

**Flight Termination System Components**

Section D417.5(a) requires that a flight termination system have a predicted reliability of 0.999 at a confidence level of 95 percent. A launch operator would demonstrate the system's predicted reliability by satisfying the requirements for system reliability analysis of section 417.309(b). Lockheed states that flight termination system reliability of 0.999 at a confidence level of 95% has been implemented at the Federal ranges as a goal and that this reliability is of limited value. The analysis required by section 417.309(b), however, reflects current practice. This provision does not require demonstration by testing; therefore, a launch operator can meet the proposed standard through analyses.

Section D417.5(c) requires that a flight termination system use redundant components that are structurally, electrically, and mechanically separated. Paragraph (c) also requires that each redundant component's mounting on a launch vehicle, including location or orientation, ensure that any failure that will damage, destroy or otherwise inhibit the operation of one redundant component will not inhibit the operation of the other redundant component and will not inhibit functioning of the flight termination system. Lockheed commented that this requirement will have to be tailored frequently if left unchanged. Boeing commented that the redundancy requirement as written would require significant vehicle redesign. The FAA will not change this requirement because separation of redundant components maximizes the reliability of a flight termination system. This is a flexible performance requirement which a launch operator may satisfy through different methods. The FAA may grandfather certain vehicles and a launch operator may also apply for relief.

Proposed section D417.7(b) would have required a launch operator to determine all maximum predicted non-operating and operating environments that a flight termination system, including each component, will experience. Lockheed suggested clarifying that environments experienced after the planned safe flight state has been achieved should not be included in the maximum predicted environment determination. The FAA agrees because when a launch vehicle reaches its safe state, which typically is when a vehicle reaches orbit, it can no longer endanger the public. The FAA adopts the clarification.

Section D417.7(b)(1) requires that for a launch vehicle configuration for which there have been fewer than three flights, the test margin for the maximum predicted environments must be no less than plus 3 dB for vibration, plus 4.5 dB for shock, and plus or minus 11 °C for thermal range. Lockheed suggested the FAA work closely with industry to establish criteria for what level of change constitutes a new vehicle configuration. The FAA agrees and intends to work closely with industry and the Federal launch range on this issue.

Section D417.7(c) contains component thermal cycle requirements. Lockheed suggested deleting the language that states how a thermal cycle is to be performed and moving the language to appendix E. Although the tests in appendix D appear to be out of place, they provide the standard to which a component must be designed. Accordingly, appendix D is the proper place for them.

Section D417.7(c) requires a component satisfy all its performance specifications when exposed to preflight and flight thermal cycle environments. Paragraph (c)(1) of section D417.7 requires that, for each component, the acceptance-number of thermal cycles be no less than eight thermal cycles or 1.5 times the maximum number of thermal cycles that the component could experience during launch processing and flight, including all launch delays and recycling, rounded up to the nearest whole number, whichever is greater. Lockheed recommends clarifying that the requirement only applies to components that are exposed to significant temperature variations during preflight processing. The FAA disagrees with Lockheed's conclusion because temperature variation may occur during launch processing and flight and must be accounted for. Regardless of whether temperature variations occur during launch processing or flight, they may still affect the performance of a component.

Section D417.7(c)(3) contains thermal cycle requirements that apply to any electronic component that contains active electronic piece-parts such as microcircuits, transistors, and diodes. Section D417.7(c)(3)(i) requires that an electronic component satisfy all its performance specifications when subjected to the sum of ten thermal cycles and the number of thermal cycles required for acceptance testing from one extreme of the maximum predicted thermal range to the other extreme. Lockheed suggested limiting the number of thermal cycles to 18. The FAA does not accept this proposal because ten cycles and the number of thermal cycles required for acceptance testing would typically result in 18 for electronic components. Test data on existing systems often shows failures after eight thermal cycles. The additional 10 acceptance-thermal cycles for a complete electronic component allows for burn-in of electronic piece-parts that make up the electronic component, minimizes the amount of testing required for the individual piece-parts, and is consistent with the approach used at the Federal ranges.

Lockheed also questioned whether section D417.7(c)(4)(iii) is a catch-all for other batteries. The FAA confirms that this section is a catch-all for ''any other power source,'' including lithium ion batteries.

Section D417.7(e) identifies the sinusoidal vibration environments that would apply to the design of a flight termination system component. Lockheed suggested changing the frequency range from +/−50% to covering the half-power points of the predicted sinusoidal vibration levels. Lockheed stated that the requirement as written could result in over testing. The FAA does not adopt the suggested change because the +/−50% frequency range provides a margin that ensures proper operation of the component under the predicted sinusoidal vibration environment.

Section D417.7(f) contains the requirements for transportation vibration levels. Lockheed suggested using the transportation vibration requirement of appendix E, instead of the levels of section D417.7(f). The FAA does not adopt this suggestion because appendix D contains design requirements and appendix E contains testing requirements. Appendix E permits either test or analysis which should remove concerns about burdensome testing. Appendix D is adopted as proposed, because it contains the design requirements that are based on all predicted environments. The transportation vibration testing requirements of appendix E are not based on predicted environments.

Proposed section D417.7(g)(1)(ii) would have required a flight termination system component to satisfy all its performance specifications when exposed to the workmanship screening forces and frequencies required by Table E417.11–2. Lockheed commented that this table is for minimum breakup shock, not for workmanship. Lockheed is correct and the FAA identifies the table as such here.

Lockheed suggested that the flight termination system installation procedures of section D417.15(b)(1) should only list training or certifications

required to safely perform hazardous tasks, instead of a list of personnel required to perform each task as proposed by section D417.15(b)(3). The FAA adopts the requirement as proposed, because a list of personnel is used to ensure each task is assigned a person, even if the same person is responsible for a number of different tasks.

Section D417.17(b)(2) requires telemetry data to show whether the power to an electronic FTS component is off or on. Lockheed suggested allowing for status of the source of power in addition to whether the power is on or off. The FAA does not adopt this suggestion because it would exceed current requirements. A launch operator may include this information in its data.

Section D417.19(c) requires a flight termination system to satisfy all its performance specifications and not sustain any damage when subjected to a maximum input voltage of no less than the maximum open circuit voltage of the component's power source. The component must satisfy all its performance specifications and not sustain any damage when subjected to a minimum input voltage of no greater than the minimum loaded voltage of the component's power source. Lockheed recommended requiring a flight termination system not sustain any damage when subjected to a maximum power input voltage of no less than the maximum open circuit voltage of the component's power source as measured at the input to the component for no less than twice the expected duration. The component must satisfy all its performance specifications when subjected to a minimum power input voltage of no greater than the minimum loaded voltage of the component's power source or the maximum loaded voltage of the component's power source as measured at the input to the component for an indefinite time. The FAA agrees that performance specifications should be met for a loaded output of the power source and should account for voltage drops in the harness. Current practice, however, is to apply the open circuit voltage. This applies a safety margin that the Federal ranges have relied upon over time.

Section D417.19(h) requires each circuit, element, component, and subsystem of a flight termination system to satisfy all its performance specifications when subjected to repetitive functioning for five times the expected number of cycles required for all acceptance testing, checkout, and operations, including re-tests caused by schedule or other delays. Lockheed suggested requiring that only components that are subject to performance degradation due to repetitive cycling satisfy this requirement. The FAA does not adopt the suggestion because all components could be subject to degradation due to repetitive cycling.

Section D417.19(j) requires a flight termination system component that uses a microprocessor to perform self-tests during flight. Lockheed suggested that during flight the self-test would be performed continuously in the background. Although the FAA agrees that a component that uses a microprocessor typically performs continuous background tests, this provision does not preclude continuous background tests.

Section D417.21 defines the requirements for flight termination system monitor checkout circuits. Lockheed requested that the FAA clarify the meaning of the term ''checkout circuit,'' and to add clarifying language. ''Checkout circuits'' mean the circuitries which provide the telemetry, in either analog or digital format, for the internal health status of a component. We did not add the suggested language because the term ''checkout circuit'' means the same as monitor circuits.

Section D417.21(c) requires that a monitor, checkout, or control circuit not route through a safe-and-arm plug. Lockheed commented that this requirement appears to be addressed in the section D417.21(b), which requires that a monitor, control, or checkout circuit may not share a connector with a firing circuit. The FAA disagrees because there may be designs that could employ the safe and arm plugs in a way that they are not part of a firing circuit but would either enable or disable the function.

Section D417.23 applies to a flight termination system ordnance train. Section D417.23(d) requires that an ordnance train include initiation devices that can be connected or removed from a destruct charge. Paragraph (d) also requires that the design of an ordnance train provide for easy access to each initiation device. Boeing commented that it is unclear what is required, because Boeing has remote safing of the systems, and would not need to disconnect the transfer lines in the destruct changes. Boeing claims it could not accomplish this on the pad, or after the tunnel covers are installed in the horizontal integration facility or high pressure test facility. Boeing's comment is focused on a specific case and the FAA reiterates that tailoring may be available for specific cases. This requirement facilitates end-to-end testing where a simulator replaces an initiator. A safe-and-arm device provides only one inhibit to inadvertent initiation of flight termination system ordnance. One inhibit is not generally sufficient for most launch processing, depending on public access to the vehicle and the potential secondary effects on public safety, such as fire or toxic release, due to inadvertent initiation of flight termination system ordnance.

Proposed section D417.25(d)(4) would have required that all input ports be isolated from all output ports. Lockheed commented that if the inputs are isolated from the outputs, then the radio frequency (RF) cannot get through the coupler. Lockheed also commented that if the intent is to require directional isolation for each port using RF circulators to prevent back feeding in the unintended direction, Atlas does not do this. The FAA agrees that the requirement does not address all types of RF couplers and may not apply to some couplers currently in use. For this reason, section D417.25(d)(4) is not adopted. Section D417.25(d)(1)–(3) still requires isolation.

Lockheed suggested adding proscriptive self test requirements for electronic components in a flight termination system in D417.27(e) by distinguishing between continuous and commanded self tests. The FAA does not adopt the suggestion; however, the performance standard will allow different approaches, including those proposed by Lockheed, to meet this requirement.

Lockheed suggested deleting paragraphs D417.27(f), D417.27(i)(1), (i)(2), and (i)(3) because they duplicate D417.19(h), D417.19(c), D417.19(e), and D417.19(i) respectively. The FAA adopts these sections because the requirements of section D417.19 apply more generally to a flight termination system, whereas the requirements of section D417.27 focus on individual components, instead of a whole system.

Lockheed suggested altering the section D417.27(j) design requirements for an electronic component used in a flight termination system so that each electronic component would have to be compatible with the electromagnetic environment it will be exposed to during preflight or flight. Lockheed also recommended against prohibiting an electronic component from producing inadvertent command outputs. The FAA does not adopt these suggestions because compatibility alone does not ensure that an electronic component will reject rogue or extraneous signals and not produce inadvertent command outputs so as to avoid inadvertent destruct actions.

Lockheed suggested limiting the performance requirements for a monitoring circuit used to receive radio frequencies for flight termination system commands to the manufacturer's specifications of section D417.29(b)(5)(ii). The FAA does not adopt this change because the current text adopts a performance standard which allows flexibility and does not require use of only the manufacturer's specifications.

For section D417.29(c), Lockheed suggested deleting several performance requirements for a command receiver decoder used to receive and then send commands for a flight termination system. This section requires a command receiver decoder to distinguish between valid and errant signals. Lockheed suggested these requirements do not reflect current practice. The FAA does not adopt the suggested deletions because it is extremely important that command receiver decoders can distinguish valid commands from similar but errant signals. A launch operator can apply for relief for alternative systems. The FAA also confirmed that these requirements reflect current practice.

Section D417.31(f) requires that the insulation resistance between wire shields and conductors and between each connector pin withstand a minimum workmanship voltage of at least 1500 volts, direct current, or 150 percent of the rated output voltage, whichever is greater. Lockheed recommends that direct current at 500 volts is sufficient to perform an adequate workmanship screening of wire harnesses. Lockheed's suggestion is already required by the workmanship screening tests of appendix E of this part.

**Flight Termination System Component Testing and Analysis**

Lockheed and Boeing requested that the FAA not require testing of a component in Appendix E to the statistical reliability of 0.999 at a 95% confidence level. This requirement appears in sections governing exploding bridgewires, percussion actuated devices and ordnance interrupters and interfaces. These sections allow the use of a statistical firing series, which include Bruceton, Langlie and Neyer tests, to comply with the above standard. Because there are different acceptable firing series, the FAA used ''firing series'' to permit greater flexibility, instead of naming individual tests. Bruceton tests do not require almost 3000 tests to demonstrate a reliability of 0.999 at a 95% confidence level. Instead, they capture the distribution of responses by incrementally varying energy levels. The FAA adopts the requirements as proposed.

Section E417.1(b) requires a launch operator to identify and implement any additional test or analysis for any new technology or any unique application of an existing technology. Lockheed suggested clarifying that the need for a new requirement may be identified by either the launch operator or the range. No change is required because under section 417.127, the FAA is able to identify and impose a unique safety policy, requirement, or practice as needed to protect the public.

Section E417.1(d)(4) identifies any change in the performance of a component sample occurring at any time during testing as a test failure even if the component satisfies other test criteria. Lockheed proposed that such changes should be evaluated and not considered an automatic failure. The FAA adopts this requirement because changes in component performance frequently result in discovery of a flaw that could lead to failure during flight.

Section E417.1(h) contains requirements for rework, repair and retesting of components that failed acceptance testing. Lockheed proposes to replace the amount of time a component is retested with an analysis of fatigue damage to the component. The FAA now requires that the total number of acceptance tests experienced by a repaired component must not exceed the environments for which the component is qualified. Lockheed's proposed fatigue equivalence satisfies the requirement.

Section E417.5(f) contains requirements that apply to X-ray or N-ray examination of components. Lockheed suggested that X-ray and N-ray examinations are not required for all production hardware and would limit what photo angles must be used. The FAA agrees that these exams are not required for all production hardware, but only for those required by the test tables. Photo angles are used not only as a recurring inspection technique; they may be required in other situations. Therefore, Lockheed's suggestion concerning photo angles is too limiting.

Section E417.7(c) requires that a component undergo each qualification test in a flight representative configuration, with all flight representative hardware such as connectors, cables, and any cable clamps, and with all attachment hardware, such as dynamic isolators, brackets and bolts, as part of that flight representative configuration. Lockheed suggested that this requirement was redundant with the requirements of section E417.11(c). The FAA does not delete this requirement because it is not redundant. Section E417.7(c) includes operating and non-operating qualification testing and analysis, whereas section E417.11(c) only applies to an operating environment.

Lockheed suggested replacing an age limit for requalifying a component proposed in section E417.7(f)(3)(i) [14] with a general exception. The proposed requirement would have prohibited qualifying or re-qualifying a component that was produced more than three years earlier. Under current practice, if a component is qualified and there are no design or material changes, the production time limit does not apply. The FAA does not, however, adopt Lockheed's suggested exception because doing so would make the exception automatic, and, as is the case now under current practice, a launch operator must first demonstrate an equivalent level of safety to qualify for an exception to this requirement.

Lockheed and Boeing recommended against the storage temperature analysis requirements in non-operating environments of subparagraphs E417.9(b)(1) & (b)(2), (b)(2)(i), (b)(2)(ii) because they believe the requirement does not represent current practice. The FAA disagrees because this section only requires a launch operator to show that the storage temperatures for a component are less than the temperatures associated with a thermal cycle or flight. This requirement may be satisfied by showing the storage temperatures are within the range of flight temperatures. No testing is required, and this is current practice.

Section E417.9(d) requires that an analysis must demonstrate that the qualification operating shock environment is more severe than the transportation shock environment. Lockheed suggested requiring that an analysis also demonstrate that acceleration environment is more severe. The FAA does not adopt this suggestion because shock includes acceleration.

Section E417.9(f) requires that any transportation vibration test subject a component to vibration in three mutually perpendicular axes for 60 minutes per axis. Lockheed suggested requiring vibration for 60 minutes per 1000 miles traveled per axis. The FAA does not adopt the suggestion because it could result in longer tests than currently required.

[14] Lockheed inadvertently cited this as a comment to E417.7(i)(6).

Lockheed suggested permitting equivalent acceleration under section E417.9(f)(2) as an alternative test method to the transportation vibration tests, which test the effect of vibrations during the transportation of components. The FAA does not adopt the suggestion because there are different ways to meet this requirement. The FAA does not want to limit the method of compliance for this requirement. Equivalent acceleration is only one possible way to satisfy the requirement; fatigue equivalence analysis is another method of compliance.

Section E417.9(i) requires a fine sand test or analysis for a component that will be exposed to sand. Lockheed suggested limiting the fine sand test to components with moving mechanical parts or exposed electrical contacts. The FAA does not adopt Lockheed's suggestion because a launch operator may meet this requirement by analysis.

Section E417.9(k) requires a component to survive the maximum predicted drop and resulting impact that could occur and go undetected during storage, transportation, or installation. Lockheed requested clarification. The FAA clarifies that the maximum predicted drop that could go undetected is a drop that does not cause visible damage.

Section E417.11 contains requirements that apply to each qualification operating environment test or analysis identified by any table of appendix E. Paragraph (b)(2) of section E417.11 requires that qualification sinusoidal vibration environment be no less than 6 dB greater than the maximum predicted sinusoidal vibration environment for no less than three times the maximum predicted duration. Lockheed suggested that the qualification sinusoidal vibration environment must account for test tolerances by allowing a nominal test level. The FAA does not adopt the suggested change because the 6 dB requirement applies to the theoretical level of the maximum predicted environment regardless of test tolerances.

Section E417.11(c)(4)(i)(A) requires that any qualification random vibration test, where a component is hard-mounted, must account for the isolator attenuation and amplification due to the maximum predicted operating random vibration environment, including any thermal effects and acceleration pre-load performance variability, and must add a 1.5 dB margin to account for any isolator attenuation variability.

Lockheed recommended against accounting for thermal effects, acceleration pre-load performance variability, and the 1.5 dB margin because this is not current practice. The FAA disagrees because this is current practice and these requirements account for isolator variability.

Lockheed suggested removing a test requirement, found in many sections, to monitor performance during the test at a sample rate of once every millisecond. Lockheed suggested replacing the above requirement with a performance standard of a sample rate that will detect any component performance degradation. The FAA agrees that a performance standard will maintain the current level of safety and adopts the proposed change.[15]

Lockheed suggested clarifying the qualification acoustic vibration test to clarify that lot acceptance components under E417.11(d)(3) do not have to meet the minimum workmanship screening test level of 144 dBA for each frequency band from 20 to 2000 Hz. This rule does not require the 144 dBA level for each frequency band from 20 to 2000 Hz. The 144 dBA level applies to all frequencies in the 20 to 2000 Hz range.

Section E417.11(g)(3)(ii) requires a humidity test to measure each electrical performance parameter at the cold and hot temperatures during the first, middle and last thermal cycles. Lockheed suggested clarifying what is meant by the middle cycle. The middle cycle is the cycle with an approximately equal number of cycles between the first cycle to the middle cycle and the middle cycle to the last cycle.

Lockheed suggested several changes to the qualification thermal vacuum test for a component covered by E417.11(i)(1) and (2). Lockheed suggested changing the environmental conditions required to conduct this test by including an exception to the pressure gradient provision. The FAA does not adopt this suggestion because the pressure gradient requirement may be met several ways, not just in the manner Lockheed suggested.

Lockheed also suggested eliminating a final vacuum dwell time because it is too long. The FAA does not adopt this suggestion because the required dwell time provides a margin necessary to ensure a component will not degrade during the thermal vacuum phase of flight.

Lockheed suggested that the FAA clarify that there is only one dwell time. The FAA does not adopt this suggestion because there may be more than one dwell time; therefore it is appropriate to identify a ''final dwell time.''

Lockheed also sought to limit the final vacuum dwell time for an acceptance thermal vacuum test in E417.13(e)(1)(ii) to be consistent with the recommended changes with E417.11(i)(2). The FAA does not adopt this suggestion because the final vacuum dwell time provides a margin and ensures that a component will not degrade during the thermal vacuum phase of flight.

Section E417.13(a) requires an acceptance test of a component to subject the component to one or more of the component's maximum predicted environments as determined under section D417.7. Lockheed suggested referring to the matrix of section 415.129(b) instead of D417.7 because the requirement could otherwise be interpreted to mean that only one of the environments must be tested. The FAA does not refer to section 415.129(b) because section D417.7 determines the maximum predicted environments to which a component must be tested. Section 415.129(b) does not determine maximum predicted environment levels. It only requires a compliance matrix.

Section E417.13(d)(1) requires the acceptance thermal cycles test to subject each component to no less than the greater of eight thermal cycles or 1.5 times the maximum number of thermal cycles that the component could experience during launch processing and flight, including all launch delays and recycling, rounded up to the nearest whole number. Lockheed described this as a new requirement that should only apply to components that experience extreme temperature variations. This requirement is current practice and applies to components that experience temperature variations that can affect their performance, regardless of whether a temperature meets an unidentified ''extreme.''

Section E417.13(d)(2)(ii) requires that an acceptance thermal cycles test subject each component to no fewer than 10 plus the acceptance-number of thermal cycles. Lockheed suggested clarifying that the 10 cycles are for burn-in only, which is intended to identify faulty components. The FAA agrees that the 10 cycles are usually for burn-in, but there are exceptions. The 10 cycles may also be used to identify mechanical failures due to thermal stress.

Section E417.13(e)(1)(iii) requires that during a final vacuum dwell-time, the environment must include no less than the maximum predicted number of thermal cycles. Lockheed suggested that

[15] The performance standard is adopted in E417.11(c)8), E417.11(d)(5), E417.11(e)(7), E417.11(f)(6), E417.13(b)(6), E417.13(c)(2)(i), E417.17(e), E417.21(k)(2), E417.21(p)(4), Table E417.21–2, Note 3, E417.22(a)(2)(iv), Table 417.22–2 Note 5, E417.25(g)(2), (g)(3), E417.27(e)(2), E417.27(f) and, Table 417.37–1, Note 5.

the requirement only account for in-flight thermal cycles and for the period of launch through the planned safe flight state. The FAA does not adopt the proposed modification because thermal cycles experienced on the ground must be accounted for. There could be significant thermal variations on the ground. For instance, fueling a launch vehicle with liquid hydrogen or oxygen exposes components to very low temperatures.

Section E417.17(b) requires that a status-of-health test of a radio frequency receiving system satisfy section E417.3(f) and include antenna voltage standing wave ratio testing that measures the assigned operating frequency at the high and low frequencies of the operating bandwidth to verify that the antenna satisfies all its performance specifications. Lockheed suggested that the FAA require the testing of components, instead of testing for a system or an antenna. The FAA does not adopt the suggestion because testing of individual components does not verify the functioning of a system into which those components are integrated.

Lockheed suggested changes to the link performance test of a radio frequency component of section E417.17(c). Lockheed stated that it is impossible to conduct this test at every possible trajectory. Testing of the receiving system does not, however, require testing every trajectory: it requires 95% of the radiation sphere surrounding the launch vehicle, which can be achieved while the vehicle is on the ground.[16] Second, Lockheed seeks to clarify which portions of paragraph (c) require analysis and which require tests. Paragraph (c) governs testing standards, not analysis. These tests may relate to required analysis, but this provision only provides test requirements.

Section E417.17(f) requires an antenna pattern test to demonstrate that the radiation gain pattern of the entire radio frequency receiving system, including the antenna, radio frequency cables, and radio frequency coupler will satisfy all the system's performance specifications during vehicle flight. Lockheed commented that the antenna pattern test does not verify link margin, but provides data used to determine the margin. Lockheed suggested referencing the link margin analysis requirement. The FAA does not adopt Lockheed's suggestion because the antenna pattern test results are used to verify the radiation gain pattern used to satisfy the gain levels of the link analysis.

Section E417.17(f)(2) requires all antenna pattern test conditions to emulate flight conditions, including ground transmitter polarization, using a simulated flight vehicle and a flight configured radio frequency command destruct system. Lockheed was concerned that this requires the use of an actual receiver. An actual receiver is not required, however, because the test can be performed with a simulated flight vehicle.

Section E417.17(f)(3) requires an antenna pattern test to measure the radiation gain for 360 degrees around the launch vehicle in degree increments that are small enough to identify any deep pattern null and to verify that the required 12 dB link margin is maintained throughout flight. Each degree increment must not exceed two degrees. Lockheed commented that link analysis determines link margin and that current practice at Federal ranges is to use 2-degree increments for the antenna pattern test. The FAA agrees that the link analysis determines the link margin. This test verifies the gain required by the link analysis. Using 2-degree increments for antenna patterns meets the requirement.

Lockheed suggested eliminating the fine sand test for a command receiver decoder (CRD) qualification test in Table E417.19–2 claiming that the test is not useful. The FAA does not accept the suggestion as it is possible a CRD may be exposed to fine sand at launch. If a launch operator can show that a CRD will not be exposed to fine sand, the launch operator may be able to obtain relief from this test.

Section E417.19(b) requires each measurement of a status-of-health test of a command receiver decoder to demonstrate that all wiring and connectors are installed according to the manufacturer's design. Lockheed commented that the test as proposed would not demonstrate that all wiring is installed according to the manufacturer's design. The FAA disagrees because a test failure indicates whether wiring is installed according to a manufacturer's design and helps identify any problems caused by improper wire installation. This section only requires verification that specific parameters related to the design are within required specifications.

Section E417.19(c)(3) requires that a command receiver decoder functional performance test demonstrate that the maximum leakage current through any command output port is at a level that cannot degrade performance of down-string electrical or ordnance initiation systems or result in an unsafe condition. The test must demonstrate no less than a 20 dB safety margin between the receiver leakage output and the lowest level that could degrade performance of down-string electrical or ordnance initiation systems or result in an unsafe condition. Lockheed suggested requiring that the maximum current must be shown by analysis to demonstrate no less than a 20 dB margin. The FAA adopts this test because the test verifies functional performance, which analysis will not accomplish.

Lockheed suggested relaxing the power dropout portion of the circuit protection test of section E417.19(d)(2) for solid state power transfer switches. The FAA does not adopt the change because Lockheed did not provide a safety justification for allowing solid state power transfer switches to comply with a new standard. It is unclear whether the standard Lockheed proposed would maintain an equivalent level of safety to the current standard.

Lockheed suggested permitting a launch operator to use analysis to meet the memory test for a receiver decoder of section E417.19(d)(6). The FAA adopts this suggestion because analysis is adequate to fulfill this requirement. At the time command codes are loaded into a receiver, the launch operator verifies the codes are loaded correctly in the memory. Memory devices used in a receiver decoder typically do not degrade. The launch operator must still use analysis to demonstrate the construction and characteristics of the memory device.

Section E417.19(e)(2)(viii) requires that a radio frequency processing test demonstrate that any radio frequency losses within a receiver decoder interface to the antenna system satisfy the required 12 dB margin. Lockheed suggested permitting this requirement be satisfied by analysis. The FAA adopts the requirement because this test is necessary to confirm the ratio which analysis generates.

Section E417.19(e)(2)(ix) requires a radio frequency processing test to demonstrate that the receiver decoder satisfies all its performance specifications within the specified tone filter frequency bandwidth using a frequency modulated tone deviation from 2 dB to 20 dB above the measured threshold level. Lockheed suggested that the requirement was new. The requirement is current practice, and command transmitter tone variations must be accounted for.

Section E417.19(e)(2)(xi) requires that a radio frequency processing test demonstrate that a receiver decoder can process commands at twice the

[16] This response also applies to Lockheed's comment on the testing of an antenna pattern of section E417.17(f)(1).

maximum and one-half the minimum timing specification of the ground system. Lockheed suggested requiring processing commands at the maximum and the minimum timing variance specification of the ground system, claiming that the requirement was new and too restrictive. The requirement is current practice and is used at the ranges to test the timing tolerance of the receiver decoder.

Section E417.19(f)(3) requires that an inadvertent command output test demonstrate that a receiver decoder rejects any out-of-band command tone frequency. The test must demonstrate that each tone filter will not respond to another tone outside the specified tone filter frequency bandwidth, using a frequency modulated tone deviation from 2 dB to 20 dB above the measured threshold level. Paragraph (f)(4) of section E417.19 requires an inadvertent command output test demonstrate that none of the tone decoder channels responds to any adjacent frequency modulated tone channel when they are frequency modulated with a minimum of 150% of the expected tone deviation. Lockheed commented that these are new requirements and that they are the same test. The FAA confirms these are current practice and are different tests because (f)(3) tests tone signal strength and (f)(4) tests tone channel frequency modulation.

For tests of a command receiver decoder and its individual components, Lockheed objected to treating as a failure any test results that showed fluctuation or variation. Fluctuation and variation are treated as failures in tests such as the input current monitor test, output functions test, and radio frequency monitor test in section E417.19(g), (h), and (i). Lockheed argued that variation or fluctuation alone should not constitute a test failure, especially because this variation could be within a components' performance standards. The FAA adopts the requirement because variations or fluctuations often indicate internal component damage, which is a potential problem that warrants further investigation.

Section E417.21(j)(3) requires that a silver-zinc battery activation procedure include verification that the electrolyte satisfies the manufacturer's specification for percentage of potassium hydroxide. Lockheed sought clarification that a chemical analysis in an acceptance data package met this requirement. The FAA confirms that a launch operator need not provide an additional chemical analysis if one is included in the acceptance data package.

Lockheed suggested clarifying an exception to the leakage test in Note 3 of Table E417.23–1. Lockheed would have permitted analysis instead of a leakage test. The FAA does not adopt this suggestion because Note 3 requires certain testing to confirm launch operator analysis; analysis cannot confirm another set of analyses for these purposes.

Section E417.25(f)(2) requires that the thermal performance test for a safe-and-arm device must continuously monitor bridgewire continuity with the safe-and-arm device in its arm position to detect each and any variation in amplitude. Paragraph (g)(2) requires that the dynamic performance test for a safe-and-arm device continuously monitor the bridgewire continuity with the safe-and-arm device in its arm position to detect each and any variation in amplitude. Any variation in amplitude in either (f)(2) or (g)(2) constitutes a test failure. Boeing commented that the requirement to continuously monitor the safe-and-arm electro explosive device during environmental exposure in these sections is new. Boeing notes that any variation in amplitude constitutes a test failure and the test fails to acknowledge that resistance changes with temperature. The FAA agrees that resistance changes with temperature. However, the change in resistance due to temperature is well understood and is accounted for in the nominal value. Only significant variations from the nominal value are considered test failures. The FAA would consider a launch operator's demonstration that variation in amplitude would not constitute a test failure.

Section E417.25(j) contains firing test requirements for a safe-and-arm device, electro-explosive device, rotor lead, or booster charge. Paragraph (j)(1)(iv) requires that each test measure ordnance output using a measuring device, such as a swell cap or dent block, to demonstrate that the output satisfies all its performance specifications. Lockheed suggested that this requirement should apply only to an EED. The FAA does not accept this change because there are other types of ordinance devices such as percussion activated devices that must be tested to make sure its performance requirements are met.

Lockheed suggested adopting a performance standard for the high temperature firing test of an ordnance interrupter, percussion activated device, explosive transfer system, ordnance manifold, and a destruct charge of sections E417.29(f)(3), E417.31(d)(3), and E417.33(b)(3) respectively, instead of the +71 °C standard in the rule. The FAA adopts the +71 °C standard because it is a temperature at which electronic components performance start to degrade, making it critical to conduct tests at or above this temperature.

Section E417.35(a) contains requirements for shock isolators that are part of a flight termination system. Paragraph (b)(4)(i)(A) requires a 1.5 dB margin for any hard-mounted acceptance random vibration test for components. Lockheed suggested not requiring the margin for shock isolators, arguing it is unnecessary, the requirements reduce the use of isolators, and that discouraging the use of isolators could adversely affect public safety. The intent of the shock isolator requirements is not to discourage their use, but rather to account for uncertainties introduced by the use of isolators. The requirements for shock isolators are the product of years of experience and capture the best current practice. Lockheed also suggested changing the status-of-health shock or vibration isolator test of section E417.35(c) to exclude vibrations representative of the maximum predicted operating environment because this was not current practice and isolators are expensive. The FAA does not adopt this proposal because the requirement is current practice, and a launch operator may satisfy it by testing only to the maximum predicted operating environment rather than having to test to many different vibration levels, which might otherwise have required additional isolators.

Table E417.37–1 requires each electrical connector or harness that is critical to the functioning of a flight termination system during flight, but is not otherwise part of a flight termination system component, to satisfy each test or analysis identified by table E417.37–1. Lockheed commented that this is a new requirement and that testing for salt fog and humidity is not done. The requirements for electrical connectors and harnesses are current practice. The requirements can be met by analysis.

Lockheed recommended deleting the status of health test for a harness or connector of section E417.37(b) because the test is pass/fail and Lockheed does not see much value in comparing past test data with a current pass/fail test. The FAA disagrees about the value of comparing test data. Although the test is pass/fail, the test produces a value. Comparison shows whether there is a wide variation in results, which may indicate further investigation is necessary.

Lockheed suggested deleting the wire and harness insulation resistance test of section E417.37(b)(4) because Lockheed did not see its value and questioned whether this applies to any wire. The FAA clarifies that this test applies to any wire and does not make the suggested change because this test is current practice and is necessary to establish whether a wire will survive its performance specifications.

Lockheed commented that the pre-flight component tests of section E417.41(b) capture current practice but suggested that the test apply to all of Appendix E. These tests do not apply throughout appendix E, but only in specific situations, such as for pre-flight components.

Lockheed suggested that the command receiver decoder of section E417.41(h)(2)(i)(4)(iii) need not be powered only by ground power or launch vehicle power. Another power source may be used. The FAA disagrees because current technology only allows for a ground or launch vehicle power source, and relief is available for future developments in power sources.

Appendix F as proposed would have contained requirements for electronic piece-parts used in critical components of a flight termination system. SpaceX commented that the current Federal range safety process is extremely expensive and time consuming for a small launch provider such as SpaceX. Current practices consume approximately 18 to 24 months. The Air Force and Army are striving to expedite the process and move towards a goal of truly operationally responsive space systems. SpaceX claimed that codifying current practices would impede the competitiveness of the industry. Instead, SpaceX said, the FAA should strive to mirror or reduce the normal requirements used at the respective launch ranges and work directly with industry to adopt the best current practices used at the Federal ranges, whether they come from the Air Force, the Army or NASA. A specific example of this is the Army's use of RCC 319 instead of EWR127–1, which allows for the use of qualified COTS hardware instead of highly specialized, much higher-priced piece parts currently required by the Air Force. The FAA does not adopt appendix F because it is not current practice at all ranges, only at the Air Force ranges. Air Force requirements are still available to an operator as a way to meet the reliability requirement. For a launch from an Air Force range, a launch operator will have to comply with Air Force requirements.

**Lightning Commit Critiera**

Appendix G requires that a launch operator apply flight commit criteria to protect against natural lightning and lightning triggered by the flight of a launch vehicle. A launch operator must apply these criteria under section 417.113 (c) for any launch vehicle that utilizes a flight safety system.

NASA's Kennedy Space Center Weather Office suggested adding certain definitions to section G417.3. The FAA adopts NASA's suggested definitions for specified volume and volume-averaged, height-integrated radar reflectivity (VAHIRR) because the definitions are integral to other changes that NASA suggested and that the FAA is adopting.

Sections G417.9 and G417.11 prohibit launch through and near non-transparent parts of attached and detached anvil clouds under certain conditions for certain time periods. Originally, the FAA proposed restrictions matching current practice at the time of the FAA's proposal. Current practice has evolved in response to new measurements and data obtained as described in comments from NASA. Accordingly, the FAA adopts NASA's proposed exceptions to these prohibitions.

As originally proposed, section G417.9 would have required that, a launch operator not initiate flight if the flight path would carry a launch vehicle through a nontransparent part of any attached anvil cloud. The FAA also proposed that for a flight path within five nautical miles (nm) of any attached anvil cloud, a launch operator would have to wait three hours after the last lightning discharge in or from a parent or anvil cloud.

NASA suggested allowing a launch operator to launch a vehicle through an attached anvil cloud within three hours after the last lightning discharge in or from the parent cloud or anvil cloud if two conditions were met: (1) The temperature along the flight path within 5 nm of the anvil cloud was colder than zero degrees Celsius, and; (2) the volume averaged height integrated radar reflectivity (VAHIRR) was below 33 dBZ–kft. NASA also suggested reducing the wait time for a flight path within 5 nm of any attached anvil cloud from 3 hours, to 30 minutes if the same two conditions were met. The FAA agrees with these exceptions because they identify additional safe launch opportunities as based on the data described in NASA's comments. The Eastern and Western Federal launch ranges already apply these exceptions. The following table describes the changes:

| G417.9 Attached Anvil Clouds | FAA proposal | FAA adopts |
|---|---|---|
| (a) Flight path through a nontransparent part of any attached anvil cloud | Can never pass through | Can pass through after 3 hours, and meeting two conditions |
| (b) Flight path within 5 nm of any attached anvil cloud | Must wait 3 hours | Can pass within 5 nm between 30 minutes and 3 hours, if 2 conditions are met |
| (c) Flight path within 10 nm of any attached anvil cloud | Must wait 30 minutes | No change |

**G417.11 Detached Anvil Clouds**

For detached anvil clouds, the FAA proposed that a launch operator not initiate flight if the flight path would carry the launch vehicle through a non-transparent part of any detached anvil cloud for the first three hours after the anvil cloud was observed to be detached from the parent cloud or the first four hours after the last lightning discharge from the detached anvil cloud. For a flight path within 5 nm of a non-transparent part of a detached anvil cloud, a launch operator would have to wait at least 3 hours after a lightning

discharge or an observed cloud detachment or meet three conditions.[17]

NASA suggested allowing an additional option for launch through or within 10 nautical miles of a non-transparent detached anvil cloud. Accordingly, under this rule, a launch operator can launch within 30 minutes from when an anvil cloud detaches from its parent, rather than the 3 hours originally proposed, if the temperature and VAHIRR conditions discussed in section G417.9 are satisfied. (1) the temperature along the flight path within 5 nm of the detached anvil cloud must be colder than zero degrees Celsius.

In accordance with the new current practice described by NASA a launch operator may launch within 5 nm of a detached anvil cloud if a launch operator can satisfy the requirements originally proposed and adopted here or if it can meet the two new conditions: (1) the temperature along the flight path within 5 nautical miles of the detached anvil cloud must be colder than zero degrees Celsius, and (2) the VAHIRR must be below 33dbZ-kft. The table below describes the changes:

| G417.11 Detached Anvil Clouds | Proposal | Final rule |
|---|---|---|
| (a) Flight path through a nontransparent part of any detached anvil cloud | Can pass through 3 hours after observed detachment or 4 hours after last lightning discharge | Two options:<br>(1) Meet FAA proposed criteria, or<br>(2) Meet 2 new conditions |
| (b) Flight path within 5 nm of any detached anvil cloud | Two options:<br>(1) Must wait 3 hours after observed detachment or last lightning discharge, or (2) Must meet 3 conditions | Three options:<br>(1) Meet FAA proposed option 1<br>(2) Meet FAA proposed option 2, or<br>(3) Meet 2 new conditions |
| (c) Flight path within 10 nm of any detached anvil cloud | Must wait 30 minutes | No change |

**Effective Date**

This final rule will become effective on August 27, 2007. The fact that these regulations are not effective for one year does not affect existing launch operator licenses.

**Paperwork Reduction Act**

As required by the Paperwork Reduction Act of 1995, 44 U.S.C. 3501 *et seq.*, the Federal Aviation Administration has reviewed the information collection requirements of this final rule. The FAA has determined that this final rule has no additional burden to respondents over and above that which the Office of Management and Budget has already approved under the existing rule titled, ''Commercial Space Transportation Licensing Regulations'' (OMB control number 2120–0608). Under the existing rule, the FAA considers license applications to launch from non-federal launch sites on a case-by-case basis. In conducting a case-by-case review, the FAA gives due consideration to current practices in space transportation, generally involving launches from federal sites, and collects information accordingly. Accordingly, the FAA believes that, under this final rule, there is no additional information collection not already included in the previously approved information collection activity. This rule would eliminate the case-by-case review, thereby streamlining the licensing process, and would not place any additional burden on the respondent.

An agency may not collect or sponsor the collection of information, nor may it impose an information collection requirement unless it displays a currently valid Office of Management and Budget (OMB) control number.

**Regulatory Evaluation Summary; Introduction**

Proposed and final rule changes to Federal regulations must undergo several economic analyses. First, Executive Order 12866 directs that each Federal agency propose or adopt a regulation only upon a reasoned determination that the benefits of the intended regulation justify its costs. Second, the Regulatory Flexibility Act of 1980 requires agencies to analyze the economic impact of regulatory changes on small entities. Third, the Trade Agreements Act prohibits agencies from setting standards that create unnecessary obstacles to the foreign commerce of the United States. In developing U.S. standards, the Trade Agreements Act also requires agencies to consider international standards and, where appropriate, use them as the basis of U.S. standards. Fourth, the Unfunded Mandates Reform Act of 1995 requires agencies to prepare a written assessment of the costs, benefits, and other effects of proposed or final rules that include a Federal mandate likely to result in the expenditure by State, local, or tribal governments, in the aggregate, or by the private sector, of $100 million or more annually (adjusted for inflation).

In conducting these analyses, the FAA has determined that the final rule: (1) Has benefits that justify its costs; while not economically significant, is ''a significant regulatory action'' as defined

[17] The conditions are: (1) There is at least one working field mill within 5 nm of the detached anvil cloud; (2) the absolute values of all electric field measurements made at the Earth's surface within 5 nm of the flight path and measurements made at each field mill have been less than 1000 volts/meter for 15 minutes or longer, and; (3) the maximum radar return from any part of the detached anvil cloud within 5 nm of the flight path has been less than 10 dBZ for 15 minutes or longer. See G417.11(c).

in the Executive Order; and is ''significant'' as defined in the Department of Transportation's Regulatory Policies and Procedures; (2) does not have a significant impact on a substantial number of small entities; (3) does not impose barriers to international trade; and (4) does not impose an unfunded mandate on State, local, or tribal governments, or on the private sector. These analyses are available in the docket, and are summarized below.

**Total Costs and Benefits of This Rulemaking**

The estimated cost of this final rule to industry and the FAA is $9.5 million ($7.9 million discounted). Potential benefits, which have not been quantified, include: increased transparency of licensing requirements, reduced likelihood that operators will deviate from the existing high level of safety achieved at federal ranges, operating efficiencies and associated cost savings, reduced uncertainties and increased confidence among the business communities, and a faster return to flight in event of a mishap. Following paragraphs provide more details on costs and benefits.

**Who is Potentially Affected by This Rulemaking**

*Private Sector*

- Commercial space transportation launch operators.
- Users of commercial space transportation.
- Users of services provided by users of commercial space transportation.
- Federal range operating contractors.

*Government*

- Federal Aviation Administration.
- Other Federal organizations such as DOD, NASA.

**Our Cost Assumptions and Sources of Information**

- Discount rate—7%.
- Period of analysis—2006 through 2010.
- All monetary values are expressed in 2004 dollars.
- Five commercial space transportation launch operators would each assign two personnel annually to review Federal range implementation of certain regulatory requirements contained in the proposed rule.
- Five commercial space transportation launch operators would each assign two industry personnel in 2006 to ensure that its records would satisfy an FAA request to provide written evidence of meets intent certifications or waivers granted previously by a Federal range.
- Annual base salary per industry personnel $116,939.
- Fringe benefit factor 23.45%.
- FAA would expend 1.5 full time personnel per year to administer and implement the proposed requirement.

**Benefits**

Benefits were not quantified but it is expected that the rule will:

- Increase transparency of existing requirements for established launch operators and new entrants;
- Preserve the high level of safety demonstrated by commercial space launch operators by reducing the likelihood that operators will deviate from current practice;
- Yield operating efficiencies by establishing standardized requirements for commercial launch operators;
- Reduce uncertainties and promote confidence among the commercial space investor and insurance communities which might stimulate business;
- Facilitate a faster return to flight in the event of a mishap because the rule will yield documentation that may be critical to mishap investigation;
- Result in industry cost savings by ensuring consistency in implementing the licensing process.

**Total Costs**

The estimated cost of this final rule is $9.5 million ($7.9 million, discounted) for five years after publication of the rule. The launch industry is expected to incur $8.7 million ($7.3 million, discounted) in costs over the five-year period. The FAA believes that a commercial space transportation launch operator will assign as many as two personnel to review Federal launch range implementation of certain regulatory requirements contained in the final rule. This will result in industry spending $7.2 million ($5.9 million, discounted) over the five-year period to increase its involvement in reviewing Federal launch range implementation of safety requirements in the final rule. Also, the final rule will require a licensed launch operator to provide written evidence, on request, demonstrating that a Federal launch range has granted a meets intent certification or waiver. Although a licensed launch operator is already required to do so by range requirements and the terms of its license, the FAA believes that the commercial space transportation industry would incur an additional $1.4 million ($1.3 million, discounted) to comply with the requirements to ensure that its records are adequate.

The FAA is expected to incur $812,000 ($666,000, discounted) in costs over the five-year period to perform more rigorous and timely launch site safety assessments.

**Summary of Incremental Cost Impacts Attributable to the Final Rulemaking**

**(In 2004 Dollars)**

| Category | Undiscounted | Discounted[a] |
|---|---|---|
| Commercial Space Transportation Industry Compliance Costs | $8,661,672 | $7,268,298 |
| Federal Aviation Administration Administrative Costs | $811,815 | $665,721 |
| Total Costs Attributable to the Final Rule | $9,473,487 | $7,934,019 |

[a] Calculated using a discount factor of seven percent over a five-year period.

**Changes From the SNPRM to the Final Rule**

The final rule differs from the SNPRM because it incorporates industry comments to the SNPRM to better capture the current practice and guidelines of the federal ranges. It better accomplishes an FAA purpose in publishing this rule: to codify current practice at the federal ranges and non-federal launch sites.

The costs estimated by the final rule regulatory evaluation differ from costs estimated by the SNPRM regulatory

evaluation. This is because better modeling techniques and better information on potential cost impacts have become available since the SNPRM was published. A summary of the differences between the SNPRM costs and the final rule costs follow.

• The regulatory evaluation for the SNPRM estimated that the proposed rule would cause two launches from the Eastern range to be delayed, at an estimated cost to industry of $700,000. The delay was attributable to modeling techniques indicating that toxic risks would exist greater than $30 \times 10^{-6}$, which would cause two launches to be delayed. Application of more refi0ned modeling techniques since publication of the SNPRM regulatory evaluation indicates that there would be no toxic risk level equal to or greater than $30 \times 10^{-6}$ associated with these launches. Accordingly, the launches would be allowed to proceed without delay under the final rule.

• The final rule regulatory evaluation estimates industry costs of approximately $1.4 million per annum, or $7.2 million (undiscounted) over a five-year period from 2006 through 2010. These costs are based on the assumption that the rule will motivate launch operators to take a more aggressive role in understanding and reviewing many of the safety-related responsibilities performed by the federal ranges; this will be accomplished by performing oversight. These costs were not included in the SNPRM regulatory evaluation and are included here to recognize launch operator concerns (of note, at a March 2005 public meeting, one commenter observed that such oversight might not take place.)

• The final rule regulatory evaluation also estimates industry costs of approximately $1.4 million (or $1.3 million undiscounted) in 2006 to comply with the final rule requirements and ensure that its records are adequate. These costs would fulfill the rule requirements for commercial launch operators to provide written evidence, on request, demonstrating that a federal range has granted a meets intent certification or waiver. These costs were not included in the SNPRM regulatory evaluation and are included here because better information and insight is available.

• The rule will result in the FAA performing more extensive reviews of federal range flight safety programs. In performing more rigorous and timely baseline assessments, the FAA will incur additional administrative cost of approximately $162,000 per annum, or $812,000 ($665,721 discounted) over the five-year period from 2006 to 2010. These costs were not included in the SNPRM regulatory evaluation and are included here because better information and insight is available.

**Regulatory Flexibility Determination**

The Regulatory Flexibility Act of 1980 establishes ''as a principle of regulatory issuance that agencies shall endeavor, consistent with the objective of the rule and of applicable statutes, to fit regulatory and informational requirements to the scale of the business, organizations, and governmental jurisdictions subject to regulation.'' To achieve that principle, the Act requires agencies ''to solicit and consider flexible regulatory proposals and to explain the rationale for their actions.'' The Act covers a wide-range of small entities, including small businesses, not-for-profit organizations and small governmental jurisdictions. Agencies must perform a review to determine whether a final rule would have a significant economic impact on a substantial number of small entities. If the determination is that it will, then the agency must prepare a regulatory flexibility analysis. In contrast, if an agency determines that a final rule is not expected to have a significant economic impact on a substantial number of small entities, then Section 605(b) of the 1980 act provides that the head of the agency may so certify and a regulatory flexibility analysis is not required.

The Small Business Administration (SBA) has defined small business entities engaged in commercial space transportation vehicles as those employing no more than 1,000 employees, using the North American Industry Classification System codes 336414, *Guided Missile and Space Vehicle Manufacturing*, 336415, *Guided Missile and Space Vehicle Propulsion Unit and Parts Manufacturing*, and 336419, *Other Guided Missile and Space Vehicle Parts and Auxiliary Equipment Manufacturing*. The SBA does not apply a size standard based on maximum annual receipts to define small business entities engaged in the commercial space transportation industry.

The final rule will cause commercial entities, operating in the commercial space launch industry prior to this proposed rulemaking, to perform more rigorous oversight of Federal launch range safety performance and to maintain adequate records of launch deviations from EWR 127–1 requirements granted by a Federal launch range. The FAA recognizes that these good business practices may not have been always performed in current practice, and also recognizes that the final rule (1) highlights commercial launch operator accountability for launch safety and oversight by commercial entities of Federal launch range performance, and (2) requires written documentation for meets intent certifications and waivers granted by the Federal launch ranges as already mandated by Federal launch range requirements. Ordinarily these activities would be expected to be performed as a matter of good business practice.

The FAA believes that the following large business entities are the principal entities currently comprising the ELV commercial space transportation launch operator industry: The Boeing Company, Lockheed Martin Corporation, International Launch Services, Incorporated, Orbital Sciences Corporation, and Sea Launch Company, L.L.C. Further, the FAA has determined that there are no existing small firms, but that there is one small business entity that is planning to enter the ELV commercial space transportation launch industry—Space Exploration Technologies Corporation (which has 20 employees). As a potential new entrant to this industry, this small business entity has neither established a launch history nor established current practices. One potential new entrant as the sole small entity does not constitute a substantial number. Accordingly, pursuant to the Regulatory Flexibility Act, 5 U.S.C. 605(b), I certify that the final rule will not have a significant economic impact on a substantial number of small entities.

**International Trade Impact Assessment**

The Trade Agreement Act of 1979 prohibits Federal agencies from promulgating any standards or engaging in any related activities that create unnecessary obstacles to the foreign commerce of the United States. Legitimate domestic objectives, such as safety, are not unnecessary obstacles; however, because the final rule will codify the intent of current practice requirements, it will not create obstacles. The statute also requires consideration of international standards and where appropriate, that they be the basis for U.S. standards. In accordance with this statute, the FAA has assessed the potential effect of the final rule and has determined that it will impose the same costs on domestic and international entities, and thus has a neutral trade impact.

**Unfunded Mandates Assessment**

The Unfunded Mandates Reform Act of 1995 (the Act) is intended, among other things, to curb the practice of

imposing unfunded Federal mandates on State, local, and tribal governments. Title II of the Act requires each Federal agency to prepare a written statement assessing the effects of any Federal mandate in a proposed or final agency rule that may result in an expenditure of $100 million or more (adjusted annually for inflation) in any one year by State, local, and tribal governments, in the aggregate, or by the private sector; such a mandate is deemed to be a ''significant regulatory action.'' The FAA currently uses an inflation-adjusted value of $120.7 million in lieu of $100 million.

This final rule does not contain such a mandate. The requirements of Title II do not apply.

**Executive Order 13132, Federalism**

The FAA has analyzed this final rule under the principles and criteria of Executive Order 13132, Federalism. We determined that this action will not have a substantial direct effect on the States, or the relationship between the national Government and the States, or on the distribution of power and responsibilities among the various levels of government, and therefore does not have Federalism implications.

**Environmental Analysis**

FAA Order 1050.1E identifies FAA actions that are categorically excluded from preparation of an environmental assessment or environmental impact statement under the National Environmental Policy Act in the absence of extraordinary circumstances. The FAA has determined this rulemaking action qualifies for the categorical exclusion identified in paragraph 312(d) and involves no extraordinary circumstances.

**Regulations That Significantly Affect Energy Supply, Distribution, or Use**

The FAA has analyzed this final rule under Executive Order 13211, Actions Concerning Regulations that Significantly Affect Energy Supply, Distribution, or Use (May 18, 2001). We have determined that it is not a ''significant energy action'' under the executive order because it is not a ''significant regulatory action'' under Executive Order 12866, and it is not likely to have a significant adverse effect on the supply, distribution, or use of energy.

**List of Subjects**

*14 CFR Part 401*

Organization and functions (Government agencies), Space transportation and exploration.

*14 CFR Part 406*

Administrative practice and procedure, Confidential business information, Investigations, Penalties, Space transportation and exploration.

*14 CFR Part 413*

Confidential business information, Space transportation and exploration.

*14 CFR Part 415*

Aviation safety, Environmental protection, Space transportation and exploration.

*14 CFR Part 417*

Aviation safety, Reporting and recordkeeping requirements, Rockets, Space transportation and exploration.

**The Amendment**

■ In consideration of the foregoing, the Federal Aviation Administration amends Chapter III of Title 14, Code of Federal Regulations as follows:

**Licensing and Safety Requirements for Launch**

## PART 401—ORGANIZATION AND DEFINITIONS

■ 1. The authority citation for part 401 continues to read as follows:

**Authority:** 49 U.S.C. 70101–70121.

■ 2. Amend § 401.5 by adding the following definitions in alphabetical order and revising the definition of ''Safety critical'' to read as follows:

**§ 401.5 Definitions.**

* * * * *

*Casualty* means serious injury or death.

* * * * *

*Equivalent* level of safety means an approximately equal level of safety as determined by qualitative or quantitative means.

*Expendable launch vehicle* means a launch vehicle whose propulsive stages are flown only once.

* * * * *

*Instantaneous impact point* means an impact point, following thrust termination of a launch vehicle, calculated in the absence of atmospheric drag effects.

* * * * *

*Launch site safety assessment* means an FAA assessment of a Federal launch range to determine if the range meets FAA safety requirements. A difference between range practice and FAA requirements is documented in the LSSA.

* * * * *

*Nominal* means, in reference to launch vehicle performance, trajectory, or stage impact point, a launch vehicle flight where all vehicle aerodynamic parameters are as expected, all vehicle internal and external systems perform exactly as planned, and there are no external perturbing influences other than atmospheric drag and gravity.

* * * * *

*Populated area* means—

(1) An outdoor location, structure, or cluster of structures that may be occupied by people;

(2) Sections of roadways and waterways that are frequented by automobile and boat traffic; or

(3) Agricultural lands, if routinely occupied by field workers.

*Public safety* means, for a particular licensed launch, the safety of people and property that are not involved in supporting the launch and includes those people and property that may be located within the boundary of a launch site, such as visitors, individuals providing goods or services not related to launch processing or flight, and any other launch operator and its personnel.

* * * * *

*Risk* means a measure that accounts for both the probability of occurrence of a hazardous event and the consequence of that event to persons or property.

*Safety critical* means essential to safe performance or operation. A safety critical system, subsystem, component, condition, event, operation, process, or item is one whose proper recognition, control, performance, or tolerance is essential to ensuring public safety. Something that is safety critical item creates a safety hazard or provide protection from a safety hazard

* * * * *

*Sigma* means a single standard deviation from a fixed value, such as a mean.

* * * * *

## PART 406—INVESTIGATIONS, ENFORCEMENT AND ADMINISTRATIVE REVIEW

■ 3. The authority citation for part 406 continues to read as follows:

**Authority:** 49 U.S.C. 70101–70121.

■ 4. Revise § 406.3(b) to read as follows:

**§ 406.3 Submissions; oral presentation in license and payload actions; standard of proof.**

* * * * *

(b) Submissions must include a detailed exposition of the evidence or arguments supporting the petition. Where an applicant must demonstrate an equivalent level of safety or fidelity,

the applicant must make a clear and convincing demonstration.

* * * * *

## PART 413—LICENSE APPLICATION PROCEDURES

■ 5. The authority citation for part 413 continues to read as follows:

**Authority:** 49 U.S.C. 70101–70121.

■ 6. Amend § 413.7 by adding paragraph (d) to read as follows:

### § 413.7 Application.

* * * * *

(d) *Measurement system consistency.* For each analysis, an applicant must employ a consistent measurements system, whether English or metric, in its application and licensing information.

## PART 415—LAUNCH LICENSE

■ 7. The authority citation for part 415 continues to read as follows:

**Authority:** 49 U.S.C. 70101–70121.

■ 8. Revise § 415.1 to read as follows:

### § 415.1 Scope.

This part establishes requirements for obtaining a license to launch an expendable launch vehicle. Requirements for preparing a license application are contained in part 413 of this chapter. Post licensing requirements governing launch from a Federal launch range and a non-Federal launch site are contained in part 417 of this chapter.

### § 415.9 [Amended]

■ 9. Amend § 415.9(b) to add the following to the end of the paragraph: '', and part 417 of this chapter.''

■ 10. Revise § 415.31(a) to read as follows:

### § 415.31 General.

(a) The FAA conducts a safety review to determine whether an applicant is capable of launching a launch vehicle and its payload without jeopardizing public health and safety and safety of property. The FAA issues a safety approval to a license applicant proposing to launch from a Federal launch range if the applicant satisfies the requirements of this subpart and has contracted with the Federal launch range for the provision of safety-related launch services and property, as long as an FAA launch site safety assessment shows that the range's launch services and launch property satisfy part 417 of this chapter. The FAA evaluates on an individual basis all other safety-related launch services and property associated with an applicant's proposal, in accordance with part 417 of this chapter. A safety approval is part of the licensing record on which the FAA's licensing determination is based.

* * * * *

■ 11. Revise § 415.35 to read as follows:

### § 415.35 Acceptable flight risk.

(a) *Flight risk through orbital insertion or impact.* Acceptable flight risk through orbital insertion for an orbital launch vehicle, and through impact for a suborbital launch vehicle, is measured in terms of the expected average number of casualties ($_eC$) to the collective members of the public exposed to debris hazards from any one launch. To obtain safety approval, an applicant must demonstrate that the risk level associated with debris from an applicant's proposed launch meets the public risk criteria of § 417.107(b)(1) of this chapter for impacting inert and impacting explosive debris.

(b) *Hazard identification and risk assessment.* To demonstrate compliance with paragraph (a) of this section, an applicant must file an analysis that identifies hazards and assesses risks to public health and safety and safety of property associated with nominal and non-nominal flight of its proposed launch.

(c) *Design.* A launch vehicle must be designed to ensure that flight risks meet the criteria of paragraph (a) of this section. An applicant must identify and describe the following:

(1) Launch vehicle structure, including physical dimensions and weight;

(2) Hazardous and safety critical systems, including propulsion systems; and

(3) Drawings and schematics for each system identified under paragraph (c)(2) of this section.

(d) *Operation.* A launch vehicle must be operated in a manner that ensures that flight risks meet the criteria of paragraph (a) of this section. An applicant must identify all launch operations and procedures that must be performed to ensure acceptable flight risk.

■ 12. Revise § 415.37 to read as follows:

### § 415.37 Flight readiness and communications plan.

(a) *Flight readiness requirements.* An applicant must designate an individual responsible for flight readiness. The applicant must file the following procedures for verifying readiness for safe flight:

(1) Launch readiness review procedures involving the applicant's flight safety personnel and Federal launch range personnel involved in the launch, as required by § 417.117(g) of this chapter.

(2) Procedures that ensure mission constraints, rules and abort procedures are listed and consolidated in a safety directive or notebook approved by licensee flight safety and Federal launch range personnel.

(3) Procedures that ensure currency and consistency of licensee and Federal launch range countdown checklists.

(4) Dress rehearsal procedures that—

(i) Ensure crew readiness under nominal and non-nominal flight conditions;

(ii) Contain criteria for determining whether to dispense with one or more dress rehearsals; and

(iii) Verify currency and consistency of licensee and Federal launch range countdown checklists.

(5) Procedures for ensuring the licensee's flight safety personnel adhere to the crew rest rules of § 417.113(f) of this chapter.

(b) *Communications plan requirements.* An applicant must file a communications plan that meets § 417.111(k) of this chapter, and that provides licensee and Federal launch range personnel communications procedures during countdown and flight.

(c) An applicant must file procedures that ensure that licensee and Federal launch range personnel receive a copy of the communications plan required by paragraph (b) of this section, and that the Federal launch range concurs in the communications plan.

■ 13. Revise § 415.39 to read as follows:

### § 415.39 Safety at end of launch.

To obtain safety approval, an applicant must demonstrate compliance with § 417.129 of this chapter, for any proposed launch of a launch vehicle with a stage or component that will reach Earth orbit.

■ 14. Revise § 415.41 to read as follows:

### § 415.41 Accident investigation plan.

An applicant must file an accident investigation plan (AIP), that satisfies § 417.111(g) of this chapter, and contains the applicant's procedures for reporting and responding to launch accidents, launch incidents, or other mishaps, as defined by § 401.5 of this chapter.

■ 15. Amend § 415.51 by adding a sentence to the end of this section to read as follows:

### § 415.51 General.

* * * The safety requirements of subpart C and F of this part and of part 417 of this chapter apply to all

payloads, whether or not the payload is otherwise exempt.

## Subpart E—[Removed and Reserved]

■ 16. Remove and reserve subpart E, consisting of §§ 415.71 through 415.90.

### §§ 415.101 and 415.103 [Redesignated as §§ 415.201 and 415.203]

■ 17. Redesignate §§ 415.101 and 415.103 as §§ 415.201 and 415.203, respectively.

■ 18. Revise subpart F to read as follows:

## Subpart F—Safety Review and Approval for Launch of an Expendable Launch Vehicle From a Non-Federal Launch Site

Sec.



## Subpart F—Safety Review and Approval for Launch of an Expendable Launch Vehicle From a Non-Federal Launch Site

### §§ 415.91 through 415.100 [Reserved]

### § 415.101 Scope and applicability.

(a) This subpart F contains requirements that an applicant must meet to obtain a safety approval when applying for a license to launch an expendable launch vehicle from a non-Federal launch site. This subpart also contains administrative requirements for a safety review, such as when and how an applicant files the required information, and the requirements for the form and content of each submission.

(b) The requirements of this subpart apply to both orbital and suborbital expendable launch vehicles.

(c) An applicant must demonstrate, through the material filed with the FAA, its ability to comply with the requirements of part 417 of this chapter. To facilitate production of the information required by this subpart, an applicant should become familiar with the requirements of part 417 of this chapter.

(d) For a launch from an exclusive use launch site, where there is no licensed launch site operator, a launch operator must satisfy the requirements of this part and the public safety application requirements of part 420 of this chapter.

### § 415.102 Definitions.

For the purposes of this subpart, the definitions of § 417.3 and § 401.5 of this chapter apply.

### § 415.103 General.

(a) The FAA conducts a safety review to determine whether an applicant is capable of conducting launch processing and flight without jeopardizing public health and safety and safety of property. The FAA issues a safety approval to a license applicant if the applicant satisfies the requirements of this subpart and demonstrates that it will meet the safety responsibilities and requirements of part 417 of this chapter.

(b) The FAA advises an applicant, in writing, of any issue raised during a safety review that would impede issuance of a safety approval. The applicant may respond, in writing, or amend its license application as required by § 413.17 of this chapter.

(c) An applicant must make available to the FAA upon request a copy of any information incorporated into a license application by reference.

(d) A safety approval is part of the licensing record on which the FAA bases its licensing determination.

### § 415.105 Pre-application consultation.

(a) An applicant must participate in a pre-application consultation meeting, as required by § 413.5 of this chapter, prior to an applicant's preparation of the initial flight safety analysis required by § 415.115.

(b) At a pre-application consultation meeting, an applicant must provide as complete a description of the planned launch or series of launches as available at the time. An applicant must provide the FAA the following information:

(1) *Launch vehicle.* Description of:

(i) Launch vehicle;

(ii) Any flight termination system; and

(iii) All hazards associated with the launch vehicle and any payload, including the type and amounts of all propellants, explosives, toxic materials and any radionuclides.

(2) *Proposed mission.*

(i) For an applicant applying for a launch specific license under § 415.3(a), the apogee, perigee, and inclination of any orbital objects and each impact location of any stage or other component.

(ii) For an applicant applying for a launch operator license under § 415.3(b), the planned range of trajectories and flight azimuths, and the range of apogees, perigees, and inclinations of any orbital objects and each impact location of any stage or other component.

(3) *Potential launch site.*

(i) Name and location of the proposed launch site, including latitude and longitude of the proposed launch point;

(ii) Identity of any launch site operator of that site; and

(iii) Identification of any facilities at the launch site that will be used for launch processing and flight.

### § 415.107 Safety review document.

(a) An applicant must file a safety review document that contains all the information required by §§ 415.109—415.133. An applicant must file the information for a safety review document as required by the outline in appendix B of this part. An applicant must file a sufficiently complete safety review document, except for the ground safety analysis report, no later than six months before the applicant brings any launch vehicle to the proposed launch site.

(b) A launch operator's safety review document must:

(1) Contain a glossary of unique terms and acronyms used in alphabetical order;

(2) Contain a listing of all referenced standards, codes, and publications;

(3) Be logically organized, with a clear and consistent page numbering system and must identify cross-referenced topics;

(4) Use equations and mathematical relationships derived from or referenced to a recognized standard or text, and must define all algebraic parameters;

(5) Include the units of all numerical values provided; and

(6) Include a legend or key that identifies all symbols used for any schematic diagrams.

(c) An applicant's safety review document may include sections not required by appendix B of this part. An applicant must identify each added section by using the word ''added'' in front of the title of the section. In the first paragraph of the section, an applicant must explain any addition to the outline in appendix B of this part.

(d) If a safety review document section required by appendix B of this part does not apply to an applicant's proposed launch, an applicant must identify the sections in the application

by the words ''not applicable'' preceding the title of the section. In the first paragraph of the section, an applicant must describe and justify why the section does not apply.

(e) An applicant may reference documentation previously filed with the FAA.

**§ 415.109 Launch description.**

An applicant's safety review document must contain the following information:

(a) *Launch site description.* An applicant must identify the proposed launch site and include the following:

(1) Boundaries of the launch site;

(2) Launch point location, including latitude and longitude;

(3) Identity of any launch site operator of that proposed site; and

(4) Identification of any facilities at the launch site that will be used for launch processing and flight.

(b) *Launch vehicle description.* An applicant must provide the following:

(1) A written description of the launch vehicle. The description must include a table specifying the type and quantities of all hazardous materials on the launch vehicle and must include propellants, explosives, and toxic materials; and

(2) A drawing of the launch vehicle that identifies:

(i) Each stage, including strap-on motors;

(ii) Physical dimensions and weight;

(iii) Location of all safety critical systems, including any flight termination hardware, tracking aids, or telemetry systems;

(iv) Location of all major launch vehicle control systems, propulsion systems, pressure vessels, and any other hardware that contains potential hazardous energy or hazardous material; and

(v) For an unguided suborbital launch vehicle, the location of the rocket's center of pressure in relation to its center of gravity for the entire flight profile.

(c) *Payload description.* An applicant must include or reference documentation previously filed with the FAA that contains the payload information required by § 415.59 for any payload or class of payload.

(d) *Trajectory.* An applicant must provide two drawings depicting trajectory information. An applicant must file additional trajectory information as part of the flight safety analysis data required by § 415.115.

(1) One drawing must depict the proposed nominal flight profile with downrange depicted on the abscissa and altitude depicted on the ordinate axis. The nominal flight profile must be labeled to show each planned staging event and its time after liftoff from launch through orbital insertion or final impact; and

(2) The second drawing must depict instantaneous impact point ground traces for each of the nominal trajectory, the three-sigma left lateral trajectory and the three-sigma right lateral trajectory determined under § 417.207 of this chapter. The trajectories must be depicted on a latitude/longitude grid, and the grid must include the outlines of any continents and islands.

(e) *Staging events.* An applicant must provide a table of nominal and ± three-sigma times for each major staging event and must describe each event, including the predicted impact point and dispersion of each spent stage.

(f) *Vehicle performance graphs.* An applicant must provide graphs of the nominal and ± three-sigma values as a function of time after liftoff for the following launch vehicle performance parameters: thrust, altitude, velocity, instantaneous impact point arc-range measured from the launch point, and present position arc-range measured from the launch point.

**§ 415.111 Launch operator organization.**

An applicant's safety review document must contain organizational charts and a description that shows that the launch operator's organization satisfies the requirements of § 417.103 of this chapter. An applicant's safety review document must also identify all persons with whom the applicant has contracted to provide safety-related goods or services for the launch of the launch vehicle.

**§ 415.113 Launch personnel certification program.**

(a) A safety review document must describe how the applicant will satisfy the personnel certification program requirements of § 417.105 of this chapter and identify by position those individuals who implement the program.

(b) An applicant's safety review document must contain a copy of its documentation that demonstrates how the launch operator implements the personnel certification program.

(c) An applicant's safety review document must contain a table listing each hazardous operation or safety critical task that certified personnel must perform. For each task, the table must identify by position the individual who reviews personnel qualifications and certifies personnel for performing the task.

**§ 415.115 Flight safety.**

(a) *Flight safety analysis.* An applicant's safety review document must describe each analysis method employed to meet the flight safety analysis requirements of part 417, subpart C, of this chapter. An applicant's safety review document must demonstrate how each analysis method satisfies the flight safety analysis requirements of part 417, subpart C, of this chapter. An applicant's safety review document must contain analysis products and other data that demonstrate the applicant's ability to meet the public risk criteria of § 417.107 of this chapter and to establish launch safety rules as required by § 417.113 of this chapter. An applicant's flight safety analysis must satisfy the following requirements:

(1) An applicant must file the proposed flight safety analysis methodology and the preliminary flight safety analysis products no later than 18 months for any orbital or guided suborbital launch vehicle, and nine months for any unguided suborbital launch vehicle, prior to bringing any launch vehicle to the proposed launch site.

(2) For a launch operator license, an applicant must file flight safety analysis products that account for the range of launch vehicles and flight trajectories applied for, or the worst case vehicle and trajectory under which flight will be attempted, no later than 6 months before the applicant brings any launch vehicle to the proposed launch site. For a launch specific license, an applicant must file flight safety analysis products that account for the actual flight conditions, no later than 6 months before the applicant brings any launch vehicle to the proposed launch site.

(3) The flight safety analysis performed by an applicant must be completed as required by subpart C of part 417 of this chapter. An applicant may identify those portions of the analysis that it expects to refine as the first proposed flight date approaches. An applicant must identify any analysis product subject to change, describe what needs to be done to finalize the product, and identify when before flight it will be finalized. If a license allows more than one launch, an applicant must demonstrate the applicability of the analysis methods to each of the proposed launches and identify any expected differences in the flight safety analysis methods among the proposed launches. Once licensed, a launch operator must perform a flight safety analysis for each launch using final launch vehicle performance and other data as required by subpart C of part 417

of this chapter and using the analysis methods approved by the FAA through the licensing process.

(b) *Radionuclides.* An applicant's safety review document must identify the type and quantity of any radionuclide on a launch vehicle or payload. For each radionuclide, an applicant must include a reference list of all documentation addressing the safety of its intended use and describe all approvals by the Nuclear Regulatory Commission for launch processing. An applicant must provide radionuclide information to the FAA at the pre-application consultation as required by § 415.105. The FAA will evaluate launch of any radionuclide on a case-by-case basis, and issue an approval if the FAA finds that the launch is consistent with public health and safety.

(c) *Flight safety plan.* An applicant's safety review document must contain a flight safety plan that satisfies § 417.111(b) of this chapter. The plan need not be restricted to public safety related issues and may combine other flight safety issues as well, such as employee safety, so as to be all-inclusive.

(d) *Natural and triggered lightning.* For any orbital or guided suborbital expendable launch vehicle, an applicant must demonstrate that it will satisfy the flight commit criteria of § 417.113(c) of this chapter and appendix G of part 417 of this chapter for natural and triggered lightning. If an applicant's safety review document states that any flight commit criterion that is otherwise required by appendix G of part 417 of this chapter does not apply to a proposed launch or series of launches, the applicant's safety review document must demonstrate that the criterion does not apply.

**§ 415.117 Ground safety.**

(a) *General.* An applicant's safety review document must include a ground safety analysis report, and a ground safety plan for its launch processing and post-flight operations as required by this section, § 417.109 of this chapter, and subpart E of part 417 of this chapter when launching from a launch point in the United States. Launch processing and post-launch operations at a launch point outside the United States may be subject to the requirements of the governing jurisdiction.

(b) *Ground safety analysis.* A ground safety analysis must review each system and operation used in launch processing and post-flight operations as required by § 417.109 of this chapter, and subpart E of part 417 of this chapter.

(1) An applicant must file an initial ground safety analysis report no later than 12 months for any orbital or guided suborbital launch vehicle, and nine months for an unguided suborbital launch vehicle, before the applicant brings any launch vehicle to the proposed launch site. An initial ground safety analysis report must be in a proposed final or near final form and identify any incomplete items. An applicant must document any incomplete items and track them to completion. An applicant must resolve any FAA comments on the initial report and file a complete ground safety analysis report, no later than two months before the applicant brings any launch vehicle to the proposed launch site. Furthermore, an applicant must keep its ground safety analysis report current. Any late developing change to a ground safety analysis report must be coordinated with the FAA as an application amendment as required by § 413.17 of this chapter as soon as the applicant identifies the need for a change.

(2) An applicant must file a ground safety analysis report that satisfies the ground safety analysis requirements of § 417.109 of this chapter, and subpart E of part 417 of this chapter.

(3) The person designated under § 417.103(b)(1) of this chapter and the person designated under § 417.103(b)(2) of this chapter must approve and sign the ground safety analysis report.

(c) *Ground safety plan.* An applicant's safety review document must contain a ground safety plan that satisfies § 417.111(c) of this chapter. The applicant must file this plan with the FAA no later than six months prior to bringing the launch vehicle to the proposed launch site. This ground safety plan must describe implementation of the hazard controls identified by an applicant's ground safety analysis and implementation of the ground safety requirements of subpart E of part 417 of this chapter. A ground safety plan must address all public safety related issues and may include other ground safety issues if an applicant intends it to have a broader scope.

**§ 415.119 Launch plans.**

An applicant's safety review document must contain the plans required by § 417.111 of this chapter, except for the countdown plan of § 417.111(l) of this chapter. An applicant's launch plans do not have to be separate documents, and may be part of other applicant documentation. An applicant must incorporate each launch safety rule established under § 417.113 of this chapter into a related launch safety plan.

**§ 415.121 Launch schedule.**

An applicant's safety review document must contain a generic launch processing schedule that identifies each review, rehearsal, and safety critical preflight operation to be conducted as required by §§ 417.117, 417.119, and 417.121 of this chapter. The launch schedule must also identify day of flight activities. The launch processing schedule must show each of these activities referenced to liftoff, such as liftoff minus three days.

**§ 415.123 Computing systems and software.**

(a) An applicant's safety review document must describe all computing systems and software that perform a safety-critical computer system function for any operation performed during launch processing or flight that could have a hazardous effect on the public as required by § 417.123 of this chapter.

(b) An applicant's safety review document must list and describe all safety-critical computer system functions involved in a proposed launch, including associated hardware and software interfaces. For each system with a safety-critical computer system function, an applicant's safety review document must:

(1) Describe all safety-critical computer system functions, including each safety-critical interface with any other system;

(2) Describe all systems, including all hardware and software, and the layout of each operator console and display;

(3) Provide flow charts or diagrams that show all hardware data busses, hardware interfaces, software interfaces, data flow, and power systems, and all operations of each safety-critical computer system function;

(4) Provide all logic diagrams and software designs;

(5) List all operator user manuals and documentation by title and date;

(6) Describe the computing system and software system safety process as required by § 417.123(a).

(7) Provide all results of computing system and software hazard analyses as required by § 417.123(c).

(8) Provide all plans and results of computing systems and software validation and verification as required by § 417.123(d).

(9) Provide all plans for software development as required by § 417.123(e).

**§ 415.125 Unique safety policies, requirements and practices.**

An applicant's safety review document must identify any public safety-related policy, requirement, or

practice that is unique to the proposed launch, or series of launches, as required by § 417.127 of this chapter. An applicant's safety review document must describe how each unique safety policy, requirement, or practice ensures the safety of the public.

**§ 415.127 Flight safety system design and operation data.**

(a) *General.* This part applies to an applicant launching an orbital or guided sub-orbital expendable launch vehicle that uses a flight safety system to protect public safety as required by § 417.107(a) of this chapter. An applicant's safety review document must contain the flight safety system data identified by this section. The applicant must file all data required by this section no later than 18 months before bringing any launch vehicle to a proposed launch site.

(b) *Flight safety system description.* A safety review document must describe an applicant's flight safety system and its operation. Part 417, subpart D of this chapter and appendices D, E, and F of part 417 of this chapter contain the flight safety system and subsystems design and operational requirements.

(c) *Flight safety system diagram.* An applicant's safety review document must contain a block diagram that identifies all flight safety system subsystems. The diagram must include the following subsystems defined in part 417, subpart D of this chapter: flight termination system; command control system; tracking; telemetry; communications; flight safety data processing, display, and recording system; and flight safety official console.

(d) *Subsystem design information.* An applicant's safety review document must contain all of the following data that applies to each subsystem identified in the block diagram required by paragraph (c) of this section:

(1) *Subsystem description.* A physical description of each subsystem and its components, its operation, and interfaces with other systems or subsystems.

(2) *Subsystem diagram.* A physical and functional diagram of each subsystem, including interfaces with other systems and subsystems.

(3) *Component location.* Drawings showing the location of all subsystem components, and the details of the mounting arrangements, as installed on the vehicle, and at the launch site.

(4) *Electronic components.* A physical description of each subsystem electronic component, including operating parameters and functions at the system and piece-part level. An applicant must also provide the name of the manufacturer and any model number of each component and identify whether the component is custom designed and built or off-the-shelf-equipment.

(5) *Mechanical components.* An illustrated parts breakdown of all mechanically operated components for each subsystem, including the name of the manufacturer and any model number.

(6) *Subsystem compatibility.* A demonstration of the compatibility of the onboard launch vehicle flight termination system with the command control system.

(7) *Flight termination system component storage, operating, and service life.* A listing of all flight termination system components that have a critical storage, operating, or service life and a summary of the applicant's procedures for ensuring that each component does not exceed its storage, operating, or service life before flight.

(8) *Flight termination system element location.* For a flight termination system, a description of where each subsystem element is located, where cables are routed, and identification of mounting attach points and access points.

(9) *Flight termination system electrical connectors and connections and wiring diagrams and schematics.* For a flight termination system, a description of all subsystem electrical connectors and connections, and any electrical isolation. The safety review document must also contain flight termination system wiring diagrams and schematics and identify the test points used for integrated testing and checkout.

(10) *Flight termination system batteries.* A description of each flight termination system battery and cell, the name of the battery or cell manufacturer, and any model numbers.

(11) *Controls and displays.* For a flight safety official console, a description of all controls, displays, and charts depicting how real time vehicle data and flight safety limits are displayed. The description must identify the scales used for displays and charts.

(e) *System analyses.* An applicant must perform the reliability and other system analyses for a flight termination system and command control system of § 417.309 of this chapter. An applicant's safety review document must contain the results of each analysis.

(f) *Environmental design.* An applicant must determine the flight termination system maximum predicted environment levels required by section D417.7 of appendix D of part 417 of this chapter, and the design environments and design margins of section D417.3 of appendix D of part 417 of this chapter. An applicant's safety review document must summarize the analyses and measurements used to derive the maximum predicted environment levels. The safety review document must contain a matrix that identifies the maximum predicted environment levels and the design environments.

(g) *Flight safety system compliance matrix.* An applicant's safety review document must contain a compliance matrix of the function, reliability, system, subsystem, and component requirements of part 417 of this chapter and appendix D of part 417 of this chapter. This matrix must identify each requirement and indicate compliance as follows:

(1) ''Yes'' if the applicant's system meets the requirement of part 417 of this chapter. The matrix must reference documentation that demonstrates compliance;

(2) ''Not applicable'' if the applicant's system design and operational environment are such that the requirement does not apply. For each such case, the applicant must demonstrate, in accordance with section 406.3(b), the non-applicability of that requirement as an attachment to the matrix; or

(3) ''Equivalent level of safety'' in each case where the applicant proposes to show that its system provides an equivalent level of safety through some means other than that required by part 417 of this chapter. For each such case, an applicant must clearly and convincingly demonstrate, as required by § 406.3(b), through a technical rationale within the matrix, or as an attachment, that the proposed alternative provides a level of safety equivalent to satisfying the requirement that it would replace.

(h) *Flight termination system installation procedures.* An applicant's safety review document must contain a list of the flight termination system installation procedures and a synopsis of the procedures that demonstrates how each of those procedures meet the requirements of section D417.15 of appendix D of part 417 of this chapter. The list must reference each procedure by title, any document number, and date.

(i) *Tracking validation procedures.* An applicant's safety review document must contain the procedures identified by § 417.121(h) of this chapter for validating the accuracy of the launch vehicle tracking data supplied to the flight safety crew.

**§ 415.129 Flight safety system test data.**

(a) *General.* An applicant's safety review document must contain the flight safety system test data required by this section for the launch of an orbital and guided suborbital expendable launch vehicle that uses a flight safety system to protect public safety as required by § 417.107(a) of this chapter. This section applies to all testing required by part 417, subpart D of this chapter and its appendices, including qualification, acceptance, age surveillance, and preflight testing of a flight safety system and its subsystems and individual components. An applicant must file all required test data, no later than 12 months before the applicant brings any launch vehicle to the proposed launch site. An applicant may file test data earlier to allow greater time for addressing issues that the FAA may identify to avoid possible impact on the proposed launch date. Flight safety system testing need not be completed before the FAA issues a launch license. Prior to flight, a licensee must successfully complete all required flight safety system testing and file the completed test reports or the test report summaries required by § 417.305(d) of this chapter and section E417.1(i) of appendix E of part 417 of this chapter.

(b) *Testing compliance matrix.* An applicant's safety review document must contain a compliance matrix of all the flight safety system, subsystem, and component testing requirements of part 417 of this chapter and appendix E to part 417 of this chapter. This matrix must identify each test requirement and indicate compliance as follows:

(1) ''Yes'' if the applicant performs the system or component testing required by part 417 of this chapter. The matrix must reference documentation that demonstrates compliance;

(2) ''Not applicable'' if the applicant's system design and operational environment are such that the test requirement does not apply. For each such case, an applicant must demonstrate, as required by § 406.3(b), of the non-applicability of that requirement as an attachment to the matrix;

(3) ''Similarity'' if the test requirement applies to a component whose design is similar to a previously qualified component. For each such case, an applicant must demonstrate similarity by performing the analysis required by appendix E of part 417 of this chapter. The matrix, or an attachment, must contain the results of each analysis; or

(4) ''Equivalent level of safety'' in each case where the applicant proposes to show that its test program provides an equivalent level of safety through some means other than that required by part 417 of this chapter. For each such case, an applicant must clearly and convincingly demonstrate through a technical rationale, within the matrix or as an attachment, that the alternative provides a level of safety equivalent to satisfying the requirement that it replaces, as required by § 406.3(c).

(c) *Test program overview and schedule.* A safety review document must contain a summary of the applicant's flight safety system test program that identifies the location of the testing and the personnel who ensure the validity of the results. A safety review document must contain a schedule for successfully completing each test before flight. The applicant must reference the schedule to the time of liftoff for the first proposed flight attempt.

(d) *Flight safety system test plans and procedures.* An applicant's safety review document must contain test plans that satisfy the flight safety system testing requirements of subpart D of part 417 of this chapter and appendix E of part 417 of this chapter. An applicant's safety review document must contain a list of all flight termination system test procedures and a synopsis of the procedures that demonstrates how they meet the test requirements of part 417 of this chapter. The list must reference each procedure by title, any document number, and date.

(e) *Test reports.* An applicant's safety review document must contain either the test reports, or a summary of the test report which captures the overall test results, including all test discrepancies and their resolution, prepared as required by § 417.305(d) of this chapter and section E417.1(i) of appendix E of part 417 of this chapter, for each flight safety system test completed at the time of license application. An applicant must file any remaining test reports or summaries before flight as required by § 417.305(d) and section E417.1(i) of appendix E of part 417 of this chapter. Upon request, the launch operator must file the complete test report with the FAA for review, if the launch operator previously filed test report summaries with the FAA.

(f) *Reuse of flight termination system components.* An applicant's safety review document must contain a reuse qualification test, refurbishment plan, and acceptance test plan for the use of any flight termination system component on more than one flight. This test plan must define the applicant's process for demonstrating that the component can satisfy all its performance specifications when subjected to the qualification test environmental levels plus the total number of exposures to the maximum expected environmental levels for each of the flights to be flown.

**§ 415.131 Flight safety system crew data.**

(a) An applicant's safety review document must identify each flight safety system crew position and the role of that crewmember during launch processing and flight of a launch vehicle.

(b) An applicant's safety review document must describe the certification program for flight safety system crewmembers established to ensure compliance with §§ 417.105 and 417.311 of this chapter.

**§ 415.133 Safety at end of launch.**

An applicant must demonstrate compliance with § 417.129 of this chapter, for any proposed launch of a launch vehicle with a stage or component that will reach Earth orbit.

**§ 415.135 Denial of safety approval.**

The FAA notifies an applicant, in writing, if it has denied safety approval for a license application. The notice states the reasons for the FAA's determination. The applicant may respond to the reasons for the determination and request reconsideration.

## Subpart G—[Amended]

**§§ 415.136 through 415.200 [Reserved]**

■ 19. Subpart G is amended by adding and reserving §§ 415.204 through 415.400.

■ 20. Add appendix B of part 415 to read as follows:

## Appendix B of Part 415—Safety Review Document Outline

This appendix contains the format and numbering scheme for a safety review document to be filed as part of an application for a launch license as required by subpart F of part 415. The applicable sections of parts 413, 415, and 417 of this chapter are referenced in the outline below.

**Safety Review Document**

1.0 Launch Description (§ 415.109)
1.1 Launch Site Description
1.2 Launch Vehicle Description
1.3 Payload Description
1.4 Trajectory
1.5 Staging Events
1.6 Vehicle Performance Graphs
2.0 Launch Operator Organization (§ 415.111)
2.1 Launch Operator Organization (§ 415.111 and § 417.103 of this chapter)
2.1.1 Organization Summary
2.1.3 Organization Charts
2.1.4 Office Descriptions and Safety Functions

21. Add part 417 to read as follows:

## PART 417—LAUNCH SAFETY



**Authority:** 49 U.S.C. 70101–70121.

### Subpart A—General and License Terms and Conditions

#### § 417.1 General information.

(a) *Scope.* This part sets forth—

(1) The responsibilities of a launch operator conducting a licensed launch of an expendable launch vehicle; and

(2) The requirements for maintaining a launch license obtained under part 415 of this chapter. Parts 413 and 415 of this chapter contain requirements for preparing a license application to

conduct a launch, including information reviewed by the FAA to conduct a policy, safety, payload, and environmental review., and a payload determination.

(b) *Applicability.*

(1) The administrative requirements for filing material with the FAA in subpart A of this part apply to all licensed launches from a Federal launch range or a non-Federal launch site, except where noted.

(2) The safety requirements of subparts B through E of this part apply to all licensed launches of expendable launch vehicles. See paragraphs (d) and (e) of this section for exceptions to this provision.

(c) *''Meets intent''* certification. For a licensed launch from a Federal launch range, a launch operator need not demonstrate to the FAA that an alternative means of satisfying a requirement of this part provides an equivalent level of safety for a launch if written evidence demonstrates that a Federal launch range has, by the effective date of this part, granted a ''meets intent certification,'' including through ''tailoring,'' that applies to the requirement and that launch. See paragraph (f) of this section for exceptions to this provision. Written evidence includes:

(1) Range flight plan approval,

(2) Missile system pre-launch safety package,

(3) Preliminary and final flight data packages,

(4) A tailored version of EWR 127–1,

(5) Range email to the FAA stating that the MIC was approved, or

(6) Operation approval.

(d) *Waiver.* For a licensed launch from a Federal launch range, a requirement of this part does not apply to a launch if written evidence demonstrates that a Federal launch range has, by the effective date of this part, granted a waiver that allows noncompliance with the requirement for that launch. See paragraph (f) of this section for exceptions to this provision. Written evidence includes:

(1) Range flight plan approval,

(2) Missile system pre-launch safety package,

(3) Preliminary and final flight data packages,

(4) A tailored version of EWR 127–1,

(5) Range email to the FAA stating that the waiver was approved, or

(6) Operation approval.

(e) *Grandfathering.* For a licensed launch from a Federal launch range, a requirement of this part does not apply to the launch if the Federal launch range's grandfathering criteria allow noncompliance with the requirement for that launch. See paragraph (f) of this section for exceptions to this provision.

(f) *Exceptions to Federal launch range meets intent certifications, waivers, and grandfathering.* Even if a licensed launch from a Federal launch range satisfies paragraph (c), (d), or (e) of this section for a requirement of this part, the requirement applies and a launch operator must satisfy the requirement, obtain FAA approval of any alternative, or obtain FAA approval for any further noncompliance if—

(1) The launch operator modifies the launch vehicle's operation or safety characteristics;

(2) The launch operator uses the launch vehicle, component, system, or subsystem in a new application;

(3) The FAA or the launch operator determines that a previously unforeseen or newly discovered safety hazard exists that is a source of significant risk to public safety; or

(4) The Federal launch range previously accepted a component, system, or subsystem, but did not then identify a noncompliance to a Federal launch range requirement.

(g) *Equivalent level of safety.* The requirements of this part apply to a launch operator and the launch operator's launch unless the launch operator clearly and convincingly demonstrates that an alternative approach provides an equivalent level of safety.

### § 417.3 Definitions and acronyms.

For the purpose of this part,

*Command control system* means the portion of a flight safety system that includes all components needed to send a flight termination control signal to an onboard vehicle flight termination system. A command control system starts with any flight termination activation switch at a flight safety crew console and ends at each command-transmitting antenna. It includes all intermediate equipment, linkages, and software and any auxiliary transmitter stations that ensure a command signal will reach the onboard vehicle flight termination system from liftoff until the launch vehicle achieves orbit or can no longer reach a populated or other protected area.

*Command destruct system* means a portion of a flight termination system that includes all components on board a launch vehicle that receive a flight termination control signal and achieve destruction of the launch vehicle. A command destruct system includes all receiving antennas, receiver decoders, explosive initiating and transmission devices, safe and arm devices and ordnance necessary to achieving destruction of the launch vehicle upon receipt of a destruct command.

*Conjunction on launch* means the approach of a launch vehicle or any launch vehicle component or payload within 200 kilometers of a manned or mannable orbiting object—

(1) During the flight of an unguided suborbital rocket; or

(2) For an orbital launch vehicle during—

(i) The ascent to initial orbital insertion and through at least one complete orbit; and

(ii) Each subsequent orbital maneuver or burn from initial park orbit, or direct ascent to a higher or interplanetary orbit.

*Countdown* means the timed sequence of events that must take place to initiate flight of a launch vehicle.

*Crossrange* means the distance measured along a line whose direction is either 90 degrees clockwise (right crossrange) or counter-clockwise (left crossrange) to the projection of a launch vehicle's planned nominal velocity vector azimuth onto a horizontal plane tangent to the ellipsoidal Earth model at the launch vehicle's sub-vehicle point. The terms right crossrange and left crossrange may also be used to indicate direction.

*Data loss flight time* means the shortest elapsed thrusting time during which a launch vehicle flown with a flight safety system can move from its normal trajectory to a condition where it is possible for the launch vehicle to endanger the public.

*Destruct* means the act of terminating the flight of a launch vehicle flown with a flight safety system in a way that destroys the launch vehicle and disperses or expends all remaining propellant and renders remaining energy sources non-propulsive before the launch vehicle or any launch vehicle component or payload impacts the Earth's surface.

*Downrange* means the distance measured along a line whose direction is parallel to the projection of a launch vehicle's planned nominal velocity vector azimuth into a horizontal plane tangent to the ellipsoidal Earth model at the launch vehicle sub-vehicle point. The term downrange may also be used to indicate direction.

*Drag impact point* means a launch vehicle instantaneous impact point corrected for atmospheric drag.

*Dwell time* means—

(1) The period during which a launch vehicle instantaneous impact point is over a populated or other protected area; or

(2) The period during which an object is subjected to a test condition.

*Explosive debris* means solid propellant fragments or other pieces of a launch vehicle or payload that result from break up of the launch vehicle during flight and that explode upon impact with the Earth's surface and cause overpressure.

*Fail-over* means a method of ensuring continuous or near continuous operation of a command transmitter system by automatically switching from a primary transmitter to a secondary transmitter when a condition exists that indicates potential failure of the primary transmitter.

*Family performance data* means—

(1) Results of launch vehicle component and system tests that represent similar characteristics for a launch vehicle component or system; and

(2) Data that is continuously updated as additional samples of a given component or system are tested.

*Flight safety limit* means criteria to ensure a set of impact limit lines established for the flight of a launch vehicle flown with a flight safety system bound the area where debris with a ballistic coefficient of three or more is allowed to impact when a flight safety system functions.

*Flight safety system* means the system that provides a means of control during flight for preventing a hazard from a launch vehicle, including any payload hazard, from reaching any populated or other protected area in the event of a launch vehicle failure. A flight safety system includes:

(1) All hardware and software used to protect the public in the event of a launch vehicle failure; and

(2) The functions of any flight safety crew.

*Flight safety crew* means the personnel, designated by a launch operator, who operate flight safety system hardware and software to monitor the flight of a launch vehicle and make a flight termination decision.

*Flight termination system* means all components, onboard a launch vehicle, that provide the ability to end a launch vehicle's flight in a controlled manner. A flight termination system consists of all command destruct systems, inadvertent separation destruct systems, or other systems or components that are onboard a launch vehicle and used to terminate flight.

*Gate* means the portion of a flight safety limit boundary through which the tracking icon of a launch vehicle flown with a flight safety system may pass without flight termination.

*In-family* means a launch vehicle component or system test result that indicates that the component or system's performance conforms to the family performance data that was established by previous test results.

*Inadvertent separation destruct system* means an automatic destruct system that uses mechanical means to trigger the destruction of a launch vehicle stage.

*Launch azimuth* means the horizontal angular direction initially taken by a launch vehicle at liftoff, measured clockwise in degrees from true north.

*Launch crew* means all personnel who control the countdown and flight of a launch vehicle or who make irrevocable operational decisions that have the potential for impacting public safety. A launch crew includes members of the flight safety crew.

*Launch processing* means all preflight preparation of a launch vehicle at a launch site, including buildup of the launch vehicle, integration of the payload, and fueling.

*Launch wait* means a relatively short period of time when launch is not permitted in order to avoid a conjunction on launch or to safely accommodate temporary intrusion into a flight hazard area. A launch wait can occur within a launch window, can delay the start of a launch window, or terminate a launch window early.

*Launch window* means a period of time during which the flight of a launch vehicle may be initiated.

*''Meets intent'' certification* means a decision by a Federal launch range to accept a substitute means of satisfying a safety requirement where the substitute provides an equivalent level of safety to that of the original requirement.

*Normal flight* means the flight of a properly performing launch vehicle whose real-time instantaneous impact point does not deviate from the nominal instantaneous impact point by more than the sum of the wind effects and the three-sigma guidance and performance deviations in the uprange, downrange, left-crossrange, or right-crossrange directions.

*Normal trajectory* means a trajectory that describes normal flight.

*Non-operating environment* means an environment that a launch vehicle component experiences before flight and when not otherwise being subjected to acceptance tests. Non-operating environments include, but need not be limited to, storage, transportation, and installation.

*Operating environment* means an environment that a launch vehicle component will experience during acceptance testing, launch countdown, and flight. Operating environments include shock, vibration, thermal cycle, acceleration, humidity, and thermal vacuum.

*Operating life* means, for a flight safety system component, the period of time beginning with activation of the component or installation of the component on a launch vehicle, whichever is earlier, for which the component is capable of satisfying all its performance specifications through the end of flight.

*Operation hazard* means a hazard derived from an unsafe condition created by a system or operating environment or by an unsafe act.

*Out-of-family* means a component or system test result where the component or system's performance does not conform to the family performance data that was established by previous test results and is an indication of a potential problem with the component or system requiring further investigation and possible corrective action.

*Passive component* means a flight termination system component that does not contain active electronic piece parts.

*Performance specification* means a statement prescribing the particulars of how a component or part is expected to perform in relation to the system that contains the component or part. A performance specification includes specific values for the range of operation, input, output, or other parameters that define the component's or part's expected performance.

*Protected area* means an area of land not controlled by a launch operator that:

(1) Is a populated area;

(2) Is environmentally sensitive; or

(3) Contains a vital national asset.

*Safety-critical computer system function* means any computer system function that, if not performed, if performed out of sequence, or if performed incorrectly, may directly or indirectly cause a public safety hazard.

*Service life* means, for a flight termination system component, the sum total of the component's storage life and operating life.

*Storage life* means, for a flight termination system component, the period of time after manufacturing of the component is complete until the component is activated or installed on a launch vehicle, whichever is earlier, during which the component may be subjected to storage environments and must remain capable of satisfying all its performance specifications.

*Sub-vehicle point* means the location on an ellipsoidal Earth model where the normal to the ellipsoid passes through the launch vehicle's center of gravity. The term is the same as the weapon system term ''sub-missile point.''

*System hazard* means a hazard associated with a system and generally exists even when no operation is occurring.

*Tracking icon* means the representation of a launch vehicle's instantaneous impact point, debris footprint, or other vehicle performance metric that is displayed to a flight safety crew during real-time tracking of the launch vehicle's flight.

*Uprange* means the distance measured along a line that is 180 degrees to the downrange direction. The term uprange may also be used to indicate direction.

*Waiver* means a decision that allows a launch operator to continue with a launch despite not satisfying a specific safety requirement and where the launch operator is not able to demonstrate an equivalent level of safety.

**§ 417.5 [Reserved].**

**§ 417.7 Public safety responsibility.**

A launch operator is responsible for ensuring the safe conduct of a licensed launch and for ensuring public safety and safety of property at all times during the conduct of a licensed launch.

**§ 417.9 Launch site responsibility.**

(a) A launch operator must ensure that launch processing at a launch site in the United States satisfies the requirements of this part. Launch processing at a launch site outside the United States may be subject to the requirements of the governing jurisdiction.

(b) For a launch from a launch site licensed under part 420 of this chapter, a launch operator must—

(1) Conduct its operations as required by any agreements that the launch site operator has with any Federal and local authorities under part 420 of this chapter; and

(2) Coordinate with the launch site operator and provide any information on its activities and potential hazards necessary for the launch site operator to determine how to protect any other launch operator, person, or property at the launch site as required by the launch site operator's obligations under § 420.55 of this chapter.

(c) For a launch from an exclusive-use site, where there is no licensed launch site operator, a launch operator must satisfy the requirements of this part and the public safety requirements of part 420 of this chapter. This subpart does not apply to licensed launches occurring from Federal launch ranges.

**§ 417.11 Continuing accuracy of license application; application for modification of license.**

(a) A launch operator must ensure the representations contained in its application are accurate for the entire term of the license. A launch operator must conduct a licensed launch and carry out launch safety procedures in accordance with its application.

(b) After the FAA issues a launch license, a launch operator must apply to the FAA for modification of a launch license if—

(1) A launch operator proposes to conduct a launch or carry out a launch safety procedure or operation in a manner that is not authorized by the license; or

(2) Any representation contained in the license application that is material to public health and safety or safety of property would no longer be accurate and complete or would not reflect the launch operator's procedures governing the actual conduct of a launch. A representation is material to public health and safety or safety of property if it alters or affects the launch operator's launch plans or procedures, class of payload, orbital destination, type of launch vehicle, flight path, launch site, launch point, or any safety system, policy, procedure, requirement, criteria or standard.

(c) A launch operator must prepare and file an application to modify a launch license under part 413 of this chapter. The launch operator must identify any part of its license or license application that a proposed modification would change or affect.

(d) The FAA reviews all approvals and determinations required by this chapter to determine whether they remain valid in light of a proposed modification. The FAA approves a modification that satisfies the requirements of this part.

(e) Upon approval of a modification, the FAA issues to a launch operator either a written approval or a license order modifying the license if a stated term or condition of the license is changed, added or deleted. A written approval has the full force and effect of a license order and is part of the licensing record.

**§ 417.13 Agreement with Federal launch range.**

Before conducting a licensed launch from a Federal launch range, a launch operator must—

(a) Enter into an agreement with a Federal launch range to provide access to and use of U.S. Government property and services required to support a licensed launch from the facility and for public safety related operations and support. The agreement must be in effect for the conduct of any licensed launch; and

(b) Comply with any requirements of the agreement with the Federal launch range that may affect public safety and safety of property during the conduct of a licensed launch, including flight safety procedures and requirements.

**§ 417.15 Records.**

(a) A launch operator must maintain all records necessary to verify that it conducts licensed launches according to representations contained in the licensee's application. A launch operator must retain records for three years after completion of all launches conducted under the license.

(b) If a launch accident or launch incident occurs, as defined by § 405.1 of this chapter, a launch operator must preserve all records related to the event until completion of any Federal investigation and the FAA advises the licensee not to retain the records. The launch operator must make available to Federal officials for inspection and copying all records that these regulations require the launch operator to maintain.

**§ 417.17 Launch reporting requirements and launch specific updates.**

(a) *General.* A launch operator must satisfy the launch reporting requirements and launch specific updates required by this section and by the terms of the launch operator's license. A launch operator must file any change to the information in the license application, not identified by this section, with the FAA as a request for license modification as required by § 417.11.

(b) *Launch reporting requirements for a launch from a Federal launch range or a non-Federal launch site.*

(1) *Launch schedule and point of contact.* For each launch, a launch operator must file a launch schedule that identifies each review, rehearsal, and safety critical launch processing. A launch operator must file a point of contact for the schedule. The launch schedule must be filed and updated in time to allow FAA personnel to participate in the reviews, rehearsals, and safety critical launch processing.

(2) *Sixty-day report.* Not later than 60 days before each flight conducted under a launch operator license, a launch operator must provide the FAA the following launch-specific information:

(i) Payload information required by § 415.59 of this chapter; and

(ii) Flight information, including the launch vehicle, planned flight path, staging and impact locations, and any on-orbit activity of the launch vehicle, including each payload delivery point.

(3) *U.S. Space Command Launch Notification.* Not later than noon, EST, 15 days before each licensed flight, a launch operator must file a completed Federal Aviation Administration/U.S. Space Command (FAA/USSPACECOM) Launch Notification Form (OMB No. 2120–0608) with the FAA.

(c) *Launch specific updates for a launch from a non-Federal launch site.* A launch operator must file a launch specific update, required by this part, and any required by the terms of the launch license, for every substantive change to the information outlined in this part. For each launch, a launch operator must file the following launch specific updates:

(1) *Flight safety system test schedule.* For each launch of a launch vehicle flown with a flight safety system, a launch operator must file an updated flight safety system test schedule and points of contact no later than six months before flight. A launch operator must immediately file any later change to ensure that the FAA has the most current data.

(2) *Launch plans.* A launch operator must file any changes or additions to its launch plans required by § 417.111 to the FAA no later than 15 days before the associated activity is to take place. A launch operator must file the countdown plan with the FAA no later than 15 days before the countdown is to take place. If a change involves the addition of a new public hazard or the elimination of any control for a previously identified public hazard, a launch operator must request a license modification under § 417.11.

(3) *Thirty-day flight safety analysis update.* A launch operator must file updated flight safety analysis products, using previously approved methodologies, for each launch no later than 30 days before flight.

(i) The launch operator:

(A) Must account for vehicle and mission specific input data;

(B) May reference previously approved analysis products and data that are applicable to the launch or data that is applicable to a series of launches;

(C) Must account for potential variations in input data that may affect any analysis product within the final 30 days before flight;

(D) Must file the analysis products using the same format and organization used in its license application; and

(E) May not change an analysis product within the final 30 days before flight unless the launch operator identified a process for making a change in that period as part of the launch operator's flight safety analysis process and the FAA approved the process by grant of a license to the launch operator.

(ii) A launch operator need not file the 30-day analysis if the launch operator:

(A) Demonstrates that the analysis filed during the license application process satisfies all the requirements of this subpart; and

(B) Demonstrates the analysis does not need to be updated to account for launch specific factors.

(4) *Flight termination system qualification test reports.* For the launch of a launch vehicle flown with a flight safety system, a launch operator must file all flight termination system qualification test reports, or test report summaries, as required by section E417.1(i) of appendix E of this part, with the FAA no later than six months before the first flight attempt . The summary must identify when and where the tests were performed and provide the results. Complete qualification test reports must be made available to the FAA upon request.

(5) *Flight termination system acceptance and age surveillance test report summaries.* For the launch of a launch vehicle flown with a flight safety system, a launch operator must file a summary of the results of each flight termination system acceptance and age surveillance test, or the complete test report, as required by section E417.1(i) of appendix E of this part, no later than 30 days before the first flight attempt for each launch . The summary must identify when and where the tests were performed and provide the results. Complete acceptance and age surveillance test reports must be made available to the FAA upon request.

(6) *Command control system acceptance test reports.* For the launch of a launch vehicle flown with a flight safety system, a launch operator must file all command control system acceptance test reports, or test report summaries, as required by § 417.305(d), with the FAA no later than 30 days before the first flight attempt. The summary must identify when and where the tests were performed and provide the results. Complete acceptance test reports must be made available to the FAA upon request.

(7) *Ground safety analysis report updates.* A launch operator must file ground safety analysis report updates with the FAA as soon as the need for the change is identified and at least 30 days before the associated activity takes place. A launch operator must file a license modification request with the FAA for each change that involves the addition of a hazard that can affect public safety or the elimination of a previously identified hazard control for a hazard that still exists.

### § 417.19 Registration of space objects.

(a) To assist the U.S. Government in implementing Article IV of the 1975 Convention on Registration of Objects Launched into Outer Space, each launch operator must provide to the FAA the information required by paragraph (b) of this section for all objects placed in space by a licensed launch, including a launch vehicle and any components, except:

(1) Any object owned and registered by the U.S. Government; and

(2) Any object owned by a foreign entity.

(b) For each object that must be registered in accordance with this section, not later than 30 days following the conduct of a licensed launch, an operator must file the following information:

(1) The international designator of the space object(s);

(2) Date and location of launch;

(3) General function of the space object; and

(4) Final orbital parameters, including:

(i) Nodal period;

(ii) Inclination;

(iii) Apogee; and

(iv) Perigee.

### § 417.21 Financial responsibility requirements.

A launch operator must comply with financial responsibility requirements as required by part 440 of this chapter and as specified in a license or license order.

### § 417.23 Compliance monitoring.

(a) A launch operator must allow access by, and cooperate with, Federal officers or employees or other individuals authorized by the FAA to observe any of its activities, or of its contractors or subcontractors, associated with the conduct of a licensed launch.

(b) For each licensed launch, a launch operator must provide the FAA with a console for monitoring the progress of the countdown and communication on all channels of the countdown communications network. A launch operator must also provide the FAA with the capability to communicate with the person designated by § 417.103(b)(1).

### § 417.25 Post launch report.

(a) For a launch operator launching from a Federal launch range, a launch

operator must file a post launch report with the FAA no later than 90 days after the launch, unless an FAA launch site safety assessment shows that the Federal launch range creates a post launch report that contains the information required by this section.

(b) For a launch operator launching from a non-Federal launch site, a launch operator must file a post launch report with the FAA no later than 90 days after the launch.

(c) The post launch report must:

(1) Identify any discrepancy or anomaly that occurred during the launch countdown and flight;

(2) Identify any deviation from any term of the license or any event otherwise material to public safety, and each corrective action to be implemented before any future flight;

(3) For the launch of launch vehicle flown with a flight safety system, identify any flight environment not consistent with the maximum predicted environment as required by § 417.307(b) and any measured wind profiles not consistent with the predictions used for the launch, as required by § 417.217(d)(2); and

(4) For the launch of an unguided suborbital launch vehicle, identify the actual impact location of all impacting stages and any impacting components, and provide a comparison of actual and predicted nominal performance.

**§§ 417.26 through 417.100 [Reserved]**

## Subpart B—Launch Safety Responsibilities

### § 417.101 Scope.

This subpart contains public safety requirements that apply to the launch of an orbital or suborbital expendable launch vehicle from a Federal launch range or other launch site. If the FAA has assessed the Federal launch range, through its launch site safety assessment, and found that an applicable range safety-related launch service or property satisfies the requirements of this subpart, then the FAA will treat the Federal launch range's launch service or property as that of a launch operator without need for further demonstration of compliance to the FAA if:

(a) A launch operator has contracted with a Federal launch range for the provision of the safety-related launch service or property; and

(b) The FAA has assessed the Federal launch range, through its launch site safety assessment, and found that the Federal launch range's safety-related launch service or property satisfy the requirements of this subpart. In this case, the FAA will treat the Federal launch range's process as that of a launch operator.

### § 417.103 Safety organization.

(a) A launch operator must maintain and document a safety organization. A launch operator must identify lines of communication and approval authority for all public safety decisions, including those regarding design, operations, and analysis. A launch operator must describe its lines of communication, both within the launch operator's organization and between the launch operator and any federal launch range or other launch site operator providing launch services, in writing. Documented approval authority shall also be employed by the launch operator throughout the life of the launch system to ensure public safety and compliance with this part.

(b) A launch operator's safety organization must include, but need not be limited to, the following launch management positions:

(1) An employee of the launch operator who has the launch operator's final approval authority for launch. This employee, referred to as the launch director in this part, must ensure compliance with this part.

(2) An employee of the launch operator who is authorized to examine all aspects of the launch operator's launch safety operations and to monitor independently personnel compliance with the launch operator's safety policies and procedures. This employee, referred to as the safety official in this part, shall have direct access to the launch director, who shall ensure that all of the safety official's concerns are addressed prior to launch.

### § 417.105 Launch personnel qualifications and certification.

(a) *General.* A launch operator must employ a personnel certification program that documents the qualifications, including education, experience, and training, for each member of the launch crew.

(b) *Personnel certification program.* A launch operator's personnel certification program must:

(1) Conduct an annual personnel qualifications review and issue individual certifications to perform safety related tasks.

(2) Revoke individual certifications for negligence or failure to satisfy certification requirements.

### § 417.107 Flight safety.

(a) *Flight safety system.* For each launch vehicle, vehicle component, and payload, a launch operator must use a flight safety system that satisfies subpart D of this part as follows, unless § 417.125 applies.

(1) *In the vicinity of the launch site.* For each launch vehicle, vehicle component, and payload, a launch operator must use a flight safety system in the vicinity of the launch site if the following exist:

(i) Any hazard from a launch vehicle, vehicle component, or payload can reach any protected area at any time during flight; or

(ii) A failure of the launch vehicle would have a high consequence to the public.

(2) *In the downrange area.* For each launch vehicle, vehicle component, and payload, a launch operator must provide a flight safety system downrange if the absence of a flight safety system would significantly increase the accumulated risk from debris impacts.

(b) *Public risk criteria.* A launch operator may initiate the flight of a launch vehicle only if flight safety analysis performed under paragraph (f) of this section demonstrates that any risk to the public satisfies the following public risk criteria:

(1) A launch operator may initiate the flight of a launch vehicle only if the risk associated with the total flight to all members of the public, excluding persons in waterborne vessels and aircraft, does not exceed an expected average number of 0.00003 casualties ($E_c \leq 30 \times 10^{-6}$) from impacting inert and impacting explosive debris, ($E_c \leq 30 \times 10^{-6}$) for toxic release, and ($E_c \leq 30 \times 10^{-6}$) for far field blast overpressure. The FAA will determine whether to approve public risk due to any other hazard associated with the proposed flight of a launch vehicle on a case-by-case basis. The $E_c$ criterion for each hazard applies to each launch from lift-off through orbital insertion, including each planned impact, for an orbital launch, and through final impact for a suborbital launch.

(2) A launch operator may initiate flight only if the risk to any individual member of the public does not exceed a casualty expectation ($E_c$ of 0.000001 per launch ($E_c \leq 1 \times 10^{-6}$) for each hazard.

(3) A launch operator must implement water borne vessel hazard areas that provide an equivalent level of safety to that provided by water borne vessel hazard areas implemented for launch from a Federal launch range.

(4) A launch operator must establish aircraft hazard areas that provide an equivalent level of safety to that provided by aircraft hazard areas implemented for launch from a Federal launch range.

(c) *Debris thresholds.* A launch operator's flight safety analysis, performed as required by paragraph (f) of this section, must account for any inert debris impact with a mean expected kinetic energy at impact greater than or equal to 11 ft-lbs and, except for the far field blast overpressure effects analysis of § 417.229, a peak incident overpressure greater than or equal to 1.0 psi due to any explosive debris impact.

(1) When using the 11 ft-lbs threshold to determine potential casualties due to blunt trauma from inert debris impacts, the analysis must:

(i) Incorporate a probabilistic model that accounts for the probability of casualty due to any debris expected to impact with kinetic energy of 11 ft-lbs or greater and satisfy paragraph (d) of this section; or

(ii) Count each expected impact with kinetic energy of 11 ft-lbs or greater to a person as a casualty.

(2) When applying the 1.0 psi threshold to determine potential casualties due to blast overpressure effects, the analysis must:

(i) Incorporate a probabilistic model that accounts for the probability of casualty due to any blast overpressures of 1.0 psi or greater and satisfy paragraph (d) of this section; or

(ii) Count each person within the 1.0 psi overpressure radius of the source explosion as a casualty. When using this approach, the analysis must compute the peak incident overpressure using the Kingery-Bulmash relationship and may not take into account sheltering, reflections, or atmospheric effects. For persons located in buildings, the analysis must compute the peak incident overpressure for the shortest distance between the building and the blast source. The analysis must count each person located anywhere in a building subjected to peak incident overpressure equal to or greater than 1.0 psi as a casualty.

(d) *Casualty modeling.* A probabilistic casualty model must be based on accurate data and scientific principles and must be statistically valid. A launch operator must obtain FAA approval of any probabilistic casualty model that is used in the flight safety analysis. If the launch takes place from a Federal launch range, the analysis may employ any probabilistic casualty model that the FAA accepts as part of the FAA's launch site safety assessment of the Federal launch range's safety process.

(e) *Collision avoidance.*

(1) A launch operator must ensure that a launch vehicle, any jettisoned components, and its payload do not pass closer than 200 kilometers to a manned or mannable orbital object—

(i) Throughout a sub-orbital launch; or

(ii) For an orbital launch:

(A) During ascent to initial orbital insertion and through at least one complete orbit; and

(B) During each subsequent orbital maneuver or burn from initial park orbit, or direct ascent to a higher or interplanetary orbit or until clear of all manned or mannable objects, whichever occurs first.

(2) A launch operator must obtain a collision avoidance analysis for each launch from United States Strategic Command or from a Federal range having an approved launch site safety assessment. United States Strategic Command calls this analysis a conjunction on launch assessment. Sections 417.231 and A417.31 of appendix A of this part contain the requirements for obtaining a collision avoidance analysis. A launch operator must use the results of the collision avoidance analysis to develop flight commit criteria for collision avoidance as required by § 417.113(b).

(f) *Flight safety analysis.* A launch operator must perform and document a flight safety analysis as required by subpart C of this part. A launch operator must not initiate flight unless the flight safety analysis demonstrates that any risk to the public satisfies the public risk criteria of paragraph (b) of this section. For a licensed launch that involves a Federal launch range, the FAA will treat an analysis performed and documented by the Federal range, and which has an FAA approved launch site safety assessment, as that of the launch operator as provided in § 417.203(d) of subpart C of this part. A launch operator must use the flight safety analysis products to develop flight safety rules that govern a launch. Section 417.113 contains the requirements for flight safety rules.

### § 417.109 Ground safety.

(a) Ground safety requirements apply to launch processing and post-launch operations at a launch site in the United States.

(b) A launch operator must protect the public from adverse effects of hazardous operations and systems associated with preparing a launch vehicle for flight at a launch site.

(c) §§ 417.111(c), 417.113(b), and 417.115(c), and subpart E of this part provide launch operator ground safety requirements.

### § 417.111 Launch plans.

(a) *General.* A launch operator must implement written launch plans that define how launch processing and flight of a launch vehicle will be conducted without adversely affecting public safety and how to respond to a launch mishap. A launch operator's launch plans must include those required by this section. A launch operator's launch plans do not have to be separate documents, and may be part of other applicant documentation. A launch operator must incorporate each launch safety rule established under § 417.113 into a related launch safety plan. The launch operator must follow each launch plan.

(b) *Flight Safety Plan.* A launch operator must implement a plan that includes the following:

(1) *Flight safety personnel.* Identification of personnel by position who:

(i) Approve and implement each part of the flight safety plan and any modifications to the plan; and

(ii) Perform the flight safety analysis and ensure that the results, including the flight safety rules and establishment of flight hazard areas, are incorporated into the flight safety plan.

(2) *Flight safety rules.* All flight safety rules required by § 417.113.

(3) *Flight safety system.* A description of any flight safety system and its operation, including any preflight safety tests that a launch operator will perform.

(4) *Trajectory and debris dispersion data.* A description of the launch trajectory. For an orbital expendable launch vehicle, the description must include each planned orbital parameter, stage burnout time and state vector, and all planned stage impact times, locations, and downrange and crossrange dispersions. For a guided or unguided suborbital launch vehicle, the description must include each planned stage impact time, location, and downrange and crossrange dispersion.

(5) *Flight hazard areas.* Identification and location of each flight hazard area established for each launch as required by § 417.223, and identification of procedures for surveillance and clearance of these areas and zones as required by paragraph (j) of this section.

(6) *Support systems and services.* Identification of any support systems and services that are part of ensuring flight safety, including any aircraft or ship that a launch operator will use during flight.

(7) *Flight safety operations.* A description of the flight safety related tests, reviews, rehearsals, and other flight safety operations that a launch operator will conduct under §§ 417.115 through 417.121. A flight safety plan must contain or incorporate by reference

written procedures for accomplishing all flight safety operations.

(8) *Unguided suborbital launch vehicles.* A launch operator's flight safety plan for the launch of an unguided suborbital rocket must meet the requirements of paragraph (b) of this section and provide the following data:

(i) Launch angle limits, as required by § 417.125(c)(3); and

(ii) All procedures for measurement of launch day winds and for performing wind weighting as required by §§ 417.125 and 417.233.

(c) *Ground safety plan.* A launch operator must implement a ground safety plan that describes implementation of the hazard controls identified by a launch operator's ground safety analysis and implementation of the ground safety requirements of subpart E of this part. A ground safety plan must address all public safety related issues and may include other ground safety issues if a launch operator intends it to have a broader scope. A ground safety plan must include the following:

(1) A description of the launch vehicle and any payload, or class of payload, identifying each hazard, including explosives, propellants, toxics and other hazardous materials, radiation sources, and pressurized systems. A ground safety plan must include figures that show the location of each hazard on the launch vehicle, and indicate where at the launch site a launch operator performs hazardous operations during launch processing.

(2) Propellant and explosive information including:

(i) Total net explosive weight of each of the launch operator's liquid and solid propellants and other explosives for each explosive hazard facility as defined by part 420 of this chapter.

(ii) For each toxic propellant, any hazard controls and process constraints determined under the launch operator's toxic release hazard analysis for launch processing performed as required by § 417.229 and appendix I of this part.

(iii) The explosive and occupancy limits for each explosive hazard facility.

(iv) Individual explosive item information, including configuration (such as, solid motor, motor segment, or liquid propellant container), explosive material, net explosive weight, storage hazard classification and compatibility group as defined by part 420 of this chapter.

(3) A graphic depiction of the layout of a launch operator's launch complex and other launch processing facilities at the launch site. The depiction must show separation distances and any intervening barriers between explosive items that affect the total net explosive weight that each facility is sited to accommodate. A launch operator must identify any proposed facility modifications or operational changes that may affect a launch site operator's explosive site plan.

(4) A description of the process for ensuring that the person designated under § 417.103(b)(2) reviews and approves any procedures and procedure changes for safety implications.

(5) Procedures that launch personnel will follow when reporting a hazard or mishap to a launch operator's safety organization.

(6) Procedures for ensuring that personnel have the qualifications and certifications needed to perform a task involving a hazard that could affect public safety.

(7) A flow chart of launch processing activities, including a list of all major tasks. The flow chart must include all hazardous tasks and identify where and when, with respect to liftoff, each hazardous task will take place.

(8) Identification of each safety clear zone and hazard area established as required by §§ 417.411 and 417.413, respectively.

(9) A summary of the means for announcing when any hazardous operation is taking place, the means for making emergency announcements and alarms, and identification of the recipients of each type of announcement.

(10) A summary of the means of prohibiting access to each safety clear zone, and implementing access control to each hazard area, including any procedures for prohibiting or allowing public access to such areas.

(11) A description of the process for ensuring that all safety precautions and verifications are in place before, during, and after hazardous operations. This includes the process for verification that an area can be returned to a non-hazardous work status.

(12) Description of each hazard control required by the ground safety analysis for each task that creates a public or launch location hazard. The hazard control must satisfy § 417.407(b).

(13) A procedure for the use of any safety equipment that protects the public, for each task that creates a public hazard or a launch location hazard.

(14) The requirement and procedure for coordinating with any launch site operator and local authorities, for each task creating a public or launch location hazard.

(15) Generic emergency procedures that apply to all emergencies and the emergency procedures that apply to each specific task that may create a public hazard, including any task that involves hazardous material, as required by § 417.407.

(16) A listing of the ground safety plan references, by title and date, such as the ground safety analysis report, explosive quantity-distance site plan and other ground safety related documentation.

(d) *Launch support equipment and instrumentation plan.* A launch operator must implement a plan that ensures the reliability of the equipment and instrumentation involved in protecting public safety during launch processing and flight. A launch support equipment and instrumentation plan must:

(1) List and describe support equipment and instrumentation;

(2) Identify all certified personnel, by position, as required by § 417.105, who operate and maintain the support equipment and instrumentation;

(3) Contain, or incorporate by reference, written procedures for support equipment and instrumentation operation, test, and maintenance that will be implemented for each launch;

(4) Identify equipment and instrumentation reliability; and

(5) Identify any contingencies that protect the public in the event of a malfunction.

(e) *Configuration management and control plan.* A launch operator must implement a plan that:

(1) Defines the launch operator's process for managing and controlling any change to a safety critical system to ensure its reliability;

(2) Identifies, for each system, each person by position who has authority to approve design changes and the personnel, by position, who maintain documentation of the most current approved design; and

(3) Contains, or incorporates by reference, all configuration management and control procedures that apply to the launch vehicle and each support system.

(f) *Frequency management plan.* A launch operator must implement a plan that:

(1) Identifies each frequency, all allowable frequency tolerances, and each frequency's intended use, operating power, and source;

(2) Provides for the monitoring of frequency usage and enforcement of frequency allocations; and

(3) Identifies agreements and procedures for coordinating use of radio frequencies with any launch site operator and any local and Federal authorities, including the Federal Communications Commission.

(g) *Flight termination system electronic piece parts program plan.* A

launch operator must implement a plan that describes the launch operator's program for selecting and testing all electronic piece parts used in any flight termination system to ensure their reliability. This plan must—

(1) Demonstrate compliance with the requirements of § 417.309(b)(2);

(2) Describe the program for selecting piece parts for use in a flight termination system;

(3) Identify performance of any derating, qualification, screening, lot acceptance testing, and lot destructive physical analysis for electronic piece parts;

(4) Identify all personnel, by position, who conduct the piece part tests;

(5) Identify the pass/fail criteria for each test for each piece part;

(6) Identify the levels to which each piece part specification will be derated; and

(7) Contain, or incorporate by reference, test procedures for each piece part.

(h) *Accident investigation plan (AIP).* A launch operator must implement a plan containing the launch operator's procedures for reporting and responding to launch accidents, launch incidents, or other mishaps, as defined by § 401.5 of this chapter. An individual, authorized to sign and certify the application as required by § 413.7(c) of this chapter, and the person designated under § 417.103(b)(2) must sign the AIP.

(1) *Reporting requirements.* An AIP must provide for—

(i) Immediate notification to the Federal Aviation Administration (FAA) Washington Operations Center in case of a launch accident, a launch incident or a mishap that involves a fatality or serious injury (as defined by 49 CFR 830.2).

(ii) Notification within 24 hours to the Associate Administrator for Commercial Space Transportation or the Federal Aviation Administration (FAA) Washington Operations Center in the event of a mishap, other than those in § 415.41 (b) (1) of this chapter, that does not involve a fatality or serious injury (as defined in 49 CFR 830.2).

(iii) Submission of a written preliminary report to the FAA, Associate Administrator for Commercial Space Transportation, in the event of a launch accident or launch incident, as defined by § 401.5 of this chapter, within five days of the event. The report must identify the event as either a launch accident or launch incident, and must include the following information:

(A) Date and time of occurrence;

(B) Description of event;

(C) Location of launch;

(D) Launch vehicle;

(E) Any payload;

(F) Vehicle impact points outside designated impact lines, if applicable;

(G) Number and general description of any injuries;

(H) Property damage, if any, and an estimate of its value;

(I) Identification of hazardous materials, as defined by § 401.5 of this chapter, involved in the event, whether on the launch vehicle, payload, or on the ground;

(J) Action taken by any person to contain the consequences of the event; and

(K) Weather conditions at the time of the event.

(2) *Response plan.* An AIP must—

(i) Contain procedures that ensure the containment and minimization of the consequences of a launch accident, launch incident or other mishap;

(ii) Contain procedures that ensure the preservation of the data and physical evidence;

(3) *Investigation plan.* An AIP must contain—

(i) Procedures for investigating the cause of a launch accident, launch incident or other mishap;

(ii) Procedures for reporting investigation results to the FAA; and

(iii) Delineated responsibilities, including reporting responsibilities for personnel assigned to conduct investigations and for any one retained by the licensee to conduct or participate in investigations.

(4) *Cooperation with FAA and NTSB.* An AIP must contain procedures that require the licensee to report to and cooperate with FAA and National Transportation Safety Board (NTSB) investigations and designate one or more points of contact for the FAA and NTSB.

(5) *Preventive measure.* An AIP must contain procedures that require the licensee to identify and adopt preventive measures for avoiding recurrence of the event.

(i) *Local agreements and public coordination plans.*

(1) Where there is a licensed launch site operator, a launch operator must implement and satisfy the launch site operator's local agreements and plans with local authorities at or near a launch site whose support is needed to ensure public safety during all launch processing and flight, as required by part 420 of this chapter.

(2) For a launch from an exclusive-use site, where there is no licensed launch site operator, a launch operator must develop and implement any agreements and plans with local authorities at or near the launch site whose support is needed to ensure public safety during all launch processing and flight, as required by part 420 of this chapter.

(3) A launch operator must implement a schedule and procedures for the release of launch information before flight, after flight, and in the event of an mishap.

(4) A launch operator must develop and implement procedures for public access to any launch viewing areas that are under a launch operator's control.

(5) A launch operator must describe its procedures for and accomplish the following for each launch—

(i) Inform local authorities of each designated hazard areas near the launch site associated with a launch vehicle's planned trajectory and any planned impacts of launch vehicle components and debris as defined by the flight safety analysis required by subpart C of this part;

(ii) Provide any hazard area information prepared as required by § 417.225 or § 417.235 to the local United States Coast Guard or equivalent local authority for issuance of the notices to mariners;

(iii) Provide hazard area information prepared as required by § 417.223 or § 417.233 for each aircraft hazard area within a flight corridor to the FAA Air Traffic Control (ATC) office or equivalent local authority having jurisdiction over the airspace through which the launch will take place for the issuance of notices to airmen;

(iv) Communicate with the local Coast Guard and the FAA ATC office or equivalent local authorities, either directly or through any launch site operator, to ensure that notices to airmen and mariners are issued and in effect at the time of flight; and

(v) Coordinate with any other local agency that supports the launch, such as local law enforcement agencies, emergency response agencies, fire departments, National Park Service, and Mineral Management Service.

(j) *Hazard area surveillance and clearance plan.* A launch operator must implement a plan that defines the process for ensuring that any unauthorized persons, ships, trains, aircraft or other vehicles are not within any hazard areas identified by the flight safety analysis or the ground safety analysis. In the plan, the launch operator must—

(1) List each hazard area that requires surveillance under §§ 417.107 and 417.223;

(2) Describe how the launch operator will provide for day-of-flight surveillance of the flight hazard area to ensure that the presence of any member of the public in or near a flight hazard area is consistent with flight commit

criteria developed for each launch as required by § 417.113;

(3) Verify the accuracy of any radar or other equipment used for hazard area surveillance and account for any inaccuracies in the surveillance system when enforcing the flight commit criteria;

(4) Identify the number of security and surveillance personnel employed for each launch and the qualifications and training each must have;

(5) Identify the location of roadblocks and other security checkpoints, the times that each station must be manned, and any surveillance equipment used; and

(6) Contain, or incorporate by reference, all procedures for launch personnel control, handling of intruders, communications and coordination with launch personnel and other launch support entities, and implementation of any agreements with local authorities and any launch site operator.

(k) *Communications plan.* A launch operator must implement a plan providing licensee personnel and Federal launch range personnel, if applicable, communications procedures during countdown and flight. Effective issuance and communication of safety-critical information during countdown must include hold/resume, go/no go, and abort commands by licensee personnel and any Federal launch range personnel, during countdown. For all launches from Federal launch ranges, the Federal launch range must concur with the communications plan. The communications plan must:

(1) Describe the authority of licensee personnel and any Federal launch range personnel by individual or position title, to issue these commands;

(2) Ensure the assignment of communication networks, so that personnel identified under this paragraph have direct access to real-time safety-critical information required for issuing hold/resume, go/no go, and abort decisions and commands;

(3) Ensure personnel, identified under this paragraph, monitor each common intercom channel during countdown and flight; and

(4) Ensure the implementation of a protocol for using defined radio telephone communications terminology.

(l) *Countdown plan.* A launch operator must develop and implement a countdown plan that verifies that each launch safety rule and launch commit criterion is satisfied, verifies that personnel can communicate during the countdown and that the communication is available after the flight; and verifies that a launch operator will be able to recover from a launch abort or delay. A countdown plan must:

(1) Cover the period of time when any launch support personnel are to be at their designated stations through initiation of flight.

(2) Include procedures for handling anomalies that occur during a countdown and events and conditions that may result in a constraint to initiation of flight.

(3) Include procedures for delaying or holding a launch when necessary to allow for corrective actions, to await improved conditions, or to accommodate a launch wait.

(4) Describe a process for resolving issues that arise during a countdown and identify each person, by position, who approves corrective actions.

(5) Include a written countdown checklist that provides a formal decision process leading to flight initiation. A countdown checklist must include the flight day preflight tests of a flight safety system required by subpart D of this part and must contain:

(i) Identification of operations and specific actions completed, verification that there are no constraints to flight, and verification that a launch operator satisfied all launch safety rules and launch commit criteria;

(ii) Time of each event;

(iii) Identification of personnel, by position, who perform each operation or specific action, including reporting to the person designated under § 417.103(b)(3);

(iv) Identification of each communication channel that a launch operator uses for reporting each event;

(v) Identification of all communication and event reporting protocols;

(vi) Polling of personnel, by position, who oversee all safety critical systems and operations, to verify that the systems and the operations are ready to proceed with the launch; and

(vii) Record of all critical communications network channels that are used for voice, video, or data transmission that support the flight safety system, during each countdown.

(6) In case of a launch abort or delay:

(i) Identify each condition that must exist in order to make another launch attempt;

(ii) Include a schedule depicting the flow of tasks and events in relation to when the abort or delay occurred and the new planned launch time; and

(iii) Identify each interface and supporting entity needed to support recovery operations.

### § 417.113 Launch safety rules.

(a) *General.* For each launch, a launch operator must satisfy written launch safety rules that govern the conduct of the launch.

(1) The launch safety rules must identify the meteorological conditions and the status of the launch vehicle, launch support equipment, and personnel under which launch processing and flight may be conducted without adversely affecting public safety.

(2) The launch safety rules must satisfy the requirements of this section.

(3) A launch operator must follow all the launch safety rules.

(b) *Ground safety rules.* The launch safety rules must include ground safety rules that govern each preflight ground operation at a launch site that has the potential to adversely affect public safety. The ground safety rules must implement the ground safety analysis of subpart E of this part.

(c) *Flight-commit criteria.* The launch safety rules must include flight-commit criteria that identify each condition that must be met in order to initiate flight.

(1) The flight-commit criteria must implement the flight safety analysis of subpart C of this part. These must include criteria for:

(i) Surveillance of any region of land, sea, or air necessary to ensure the number and location of members of the public are consistent with the inputs used for the flight safety analysis of subpart C of this part;

(ii) Monitoring of any meteorological condition and implementing any flight constraint developed using appendix G of this part. The launch operator must have clear and convincing evidence that the lightning flight commit criteria of appendix G, which apply to the conditions present at the time of lift-off, are not violated. If any other hazardous conditions exist, other than those identified by appendix G, the launch weather team will report the hazardous condition to the official designated under § 417.103(b)(1), who will determine whether initiating flight would expose the launch vehicle to a lightning hazard and not initiate flight in the presence of the hazard; and

(iii) Implementation of any launch wait in the launch window for the purpose of collision avoidance.

(2) For a launch that uses a flight safety system, the flight-commit criteria must ensure that the flight safety system is ready for flight. This must include criteria for ensuring that:

(i) The flight safety system is operating to ensure the launch vehicle will launch within all flight safety limits;

(ii) Any command transmitter system required by section D417.9 has sufficient coverage from lift-off to the

point in flight where the flight safety system is no longer required by § 417.107(a);

(iii) The launch vehicle tracking system has no less than two tracking sources prior to lift-off. The launch vehicle tracking system has no less than one verified tracking source at all times from lift-off to orbit insertion for an orbital launch, to the end of powered flight for a suborbital launch; and

(iv) The launch operator will employ its flight safety system as designed in accordance with this part.

(3) For each launch, a launch operator must document the actual conditions used for the flight-commit criteria at the time of lift-off and verify whether the flight-commit criteria are satisfied.

(d) *Flight termination rules.* For a launch that uses a flight safety system, the launch safety rules must identify the conditions under which the flight safety system, including the functions of the flight safety system crew, must terminate flight to ensure public safety. These flight termination rules must implement the flight safety analysis of subpart C of this part and include each of the following:

(1) The flight safety system must terminate flight when valid, real-time data indicate the launch vehicle has violated any flight safety limit of § 417.213;

(2) The flight safety system must terminate flight at the straight-up-time required by § 417.215 if the launch vehicle continues to fly a straight up trajectory and, therefore, does not turn downrange when it should;

(3) The flight safety system must terminate flight when all of the following conditions exist:

(i) Real-time data indicate that the performance of the launch vehicle is erratic;

(ii) The potential exists for the loss of flight safety system control of the launch vehicle and further flight has the potential to endanger the public.

(4) The flight termination rules must incorporate the data-loss flight times and planned safe flight state of § 417.219, including each of the following:

(i) The flight safety system must terminate flight no later than the first data-loss flight time if, by that time, tracking of the launch vehicle is not established and vehicle position and status is unknown; and

(ii) Once launch vehicle tracking is established and there is a subsequent loss of verified tracking data before the planned safe flight state and verified tracking data is not received again, the flight safety system must terminate flight no later than the expiration of the data-loss flight time for the point in flight that the data was lost.

(5) For any gate established under § 417.217, both of the following apply:

(i) The flight safety system must terminate flight if the launch vehicle is performing erratically immediately prior to entering the gate.

(ii) The flight termination rules may permit the instantaneous impact point or other tracking icon to cross the gate only if there is no indication that the launch vehicle's performance has become erratic and the launch vehicle is either flying parallel to the nominal trajectory or converging to the nominal trajectory.

(6) For any hold-and-resume gate established under § 417.218;

(i) The flight safety system must terminate flight if the launch vehicle is performing erratically immediately prior to entering a hold gate.

(ii) The flight termination rules may permit the instantaneous impact point or other tracking icon to cross a hold gate only if there is no indication that the launch vehicle's performance has become erratic and the vehicle is either flying parallel to the nominal trajectory or converging to the nominal trajectory.

(iii) The flight termination rules of paragraphs (d)(1), (d)(3), and (d)(4) of this section apply after the instantaneous impact point or other tracking icon exits a resume gate.

(e) *Flight safety system safing.* For a launch that uses a flight safety system, the launch safety rules must ensure that any safing of the flight safety system occurs on or after the point in flight where the flight safety system is no longer required by § 417.107(b).

(f) *Launch crew work shift and rest rules.* For any operation with the potential to have an adverse effect on public safety, the launch safety rules must ensure the launch crew is physically and mentally capable of performing all assigned tasks. These rules must govern the length, number, and frequency of work shifts, including the rest afforded the launch crew between shifts.

### § 417.115 Tests.

(a) *General.* All flight, communication, and ground systems and equipment that a launch operator uses to protect the public from any adverse effects of a launch, must undergo testing as required by this part, and any corrective action and re-testing necessary to ensure reliable operation. A launch operator must—

(1) Coordinate test plans and all associated test procedures with any launch site operator or local authorities, as required by local agreements, associated with the operation; and

(2) Make test results, test failure reports, information on any corrective actions implemented and the results of re-test available to the FAA upon request.

(b) *Flight safety system testing.* A launch operator must only use a flight safety system and all flight safety system components, including any onboard launch vehicle flight termination system, command control system, and support system that satisfy the test requirements of subpart D of this part.

(c) *Ground system testing.* A launch operator must only use a system or equipment used to support hazardous ground operations identified by the ground safety analysis required by § 417.405 that satisfies the test requirements of paragraph (a) of this section.

### § 417.117 Reviews.

(a) *General.* A launch operator must—

(1) Review the status of operations, systems, equipment, and personnel required by part 417;

(2) Maintain and implement documented criteria for successful completion of each review;

(3) Track to completion and document any corrective actions or issues identified during a review; and

(4) Ensure that launch operator personnel who oversee a review attest to successful completion of the review's criteria in writing.

(b) A launch operator must conduct the following reviews:

(1) *Hazardous operations safety readiness reviews.* A launch operator must conduct a review before performing any hazardous operation with the potential to adversely affect public safety. The review must determine a launch operator's readiness to perform the operation and ensure that safety provisions are in place. The review must determine the readiness status of safety systems and equipment and verify that the personnel involved satisfy certification and training requirements.

(2) *Launch safety review.* For each launch, a launch operator must conduct a launch safety review no later than 15 days before the planned day of flight, or as agreed to by the FAA during the application process. This review must determine the readiness of ground and flight safety systems, safety equipment, and safety personnel to support a flight attempt. Successful completion of a launch safety review must ensure satisfaction of the following criteria:

(i) A launch operator must verify that all safety requirements have been or will

be satisfied before flight. The launch operator must resolve all safety related action items.

(ii) A launch operator must assign and certify flight safety personnel as required by § 417.105.

(iii) The flight safety rules and flight safety plan must incorporate a final flight safety analysis as required by subpart C of this part.

(iv) A launch operator must verify, at the time of the review, that the ground safety systems and personnel satisfy or will satisfy all requirements of the ground safety plan for support of flight.

(v) A launch operator must accomplish the safety related coordination with any launch site operator or local authorities as required by local agreements.

(vi) A launch operator must verify the filing of all safety related information for a specific launch with the FAA, as required by FAA regulations and any special terms of a license. A launch operator must verify that information filed with the FAA reflects the current status of safety-related systems and processes for each specific launch.

(3) *Launch readiness review for flight.* A launch operator must conduct a launch readiness review for flight as required by this section within 48 hours of flight. A person, identified as required by § 417.103(b)(1), must review all preflight testing and launch processing conducted up to the time of the review; and review the status of systems and support personnel to determine readiness to proceed with launch processing and the launch countdown. A decision to proceed must be in writing and signed by the person identified as required by § 417.103(b)(1), and any launch site operator or Federal launch range. A launch operator, during the launch readiness review, must poll the FAA to verify that the FAA has identified no issues related to the launch operator's license. During a launch readiness review, the launch operator must account for the following information:

(i) Readiness of launch vehicle and payload.

(ii) Readiness of any flight safety system and personnel and the results of flight safety system testing.

(iii) Readiness of safety-related launch property and services to be provided by a Federal launch range.

(iv) Readiness of all other safety-related equipment and services.

(v) Readiness of launch safety rules and launch constraints.

(vi) Status of launch weather forecasts.

(vii) Readiness of abort, hold and recycle procedures.

(viii) Results of rehearsals conducted as required by § 417.119.

(ix) Unresolved safety issues as of the time of the launch readiness review and plans for their resolution.

(x) Additional safety information that may be required to assess readiness for flight.

(xi) To review launch failure initial response actions and investigation roles and responsibilities.

### § 417.119 Rehearsals.

(a) *General.* A launch operator must rehearse its launch crew and systems to identify corrective actions needed to ensure public safety. The launch operator must conduct all rehearsals as follows:

(1) A launch operator must assess any anomalies identified by a rehearsal, and must incorporate any changes to launch processing and flight needed to correct any anomaly that is material to public safety.

(2) A launch operator must inform the FAA of any public safety related anomalies and related changes in operations performed during launch processing or flight resulting from a rehearsal.

(3) For each launch, each person with a public safety critical role who will participate in the launch processing or flight of a launch vehicle must participate in at least one related rehearsal that exercises his or her role during nominal and non-nominal conditions so that the launch vehicle will not harm the public.

(4) A launch operator must conduct the rehearsals identified in this section for each launch.

(5) At least one rehearsal must simulate normal and abnormal preflight and flight conditions to exercise the launch operator's launch plans.

(6) A launch operator may conduct rehearsals at the same time if joint rehearsals do not create hazardous conditions, such as changing a hardware configuration that affects public safety, during the rehearsal.

(b) *Countdown rehearsal.* A launch operator must conduct a rehearsal using the countdown plan, procedures, and checklist required by § 417.111(l). A countdown rehearsal must familiarize launch personnel with all countdown activities, demonstrate that the planned sequence of events is correct, and demonstrate that there is adequate time allotted for each event. A launch operator must hold a countdown rehearsal after the assembly of the launch vehicle and any launch support systems into their final configuration for flight and before the launch readiness review required by § 417.117.

(c) *Emergency response rehearsal.* A launch operator must conduct a rehearsal of the emergency response section of the accident investigation plan required by § 417.111(h)(2). A launch operator must conduct an emergency response rehearsal for a first launch of a new vehicle, for any additional launch that involves a new safety hazard, or for any launch where more than a year has passed since the last rehearsal.

(d) *Communications rehearsal.* A launch operator must rehearse each part of the communications plan required by § 417.111(k), either as part of another rehearsal or during a communications rehearsal.

### § 417.121 Safety critical preflight operations.

(a) *General.* A launch operator must perform safety critical preflight operations that protect the public from the adverse effects of hazards associated with launch processing and flight of a launch vehicle. The launch operator must identify all safety critical preflight operations in the launch schedule required by § 417.17(b)(1). Safety critical preflight operations must include those defined in this section.

(b) *Countdown.* A launch operator must implement its countdown plan, of § 417.111(l), for each launch. A launch operator must disseminate a countdown plan to all personnel responsible for the countdown and flight of a launch vehicle, and each person must follow that plan.

(c) *Collision avoidance.* A launch operator must coordinate with United States Strategic Command to obtain a collision avoidance analysis, also referred to as a conjunction on launch assessment, as required by § 417.231. A launch operator must implement flight commit criteria as required by § 417.113(b) to ensure that each launch meets all the criteria of § 417.107(e).

(d) *Meteorological data.* A launch operator must conduct operations and coordinate with weather organizations, as needed, to obtain accurate meteorological data to support the flight safety analysis required by subpart C of this part and to ensure compliance with the flight commit criteria required by § 417.113.

(e) *Local notification.* A launch operator must implement its local agreements and public coordination plan of § 417.111(i).

(f) *Hazard area surveillance.* A launch operator must implement its hazard area surveillance and clearance plan, of § 417.111(j), to meet the public safety criteria of § 417.107(b) for each launch.

(g) *Flight safety system preflight tests.* A launch operator must conduct preflight tests of any flight safety system as required by section E417.41 of appendix E of this part.

(h) *Launch vehicle tracking data verification.* For each launch, a launch operator must implement written procedures for verifying the accuracy of any launch vehicle tracking data provided. For a launch vehicle flown with a flight safety system, any source of tracking data must satisfy the requirements of § 417.307(b).

(i) *Unguided suborbital rocket preflight operations.* For the launch of an unguided suborbital rocket, in addition to meeting the other requirements of this section, a launch operator must perform the preflight wind weighting and other preflight safety operations required by §§ 417.125, 417.233, and appendix C of this part.

### § 417.123 Computing systems and software.

(a) A launch operator must document a system safety process that identifies the hazards and assesses the risks to public health and safety and the safety of property related to computing systems and software.

(b) A launch operator must identify all safety-critical functions associated with its computing systems and software. Safety-critical computing system and software functions must include the following:

(1) Software used to control or monitor safety-critical systems.

(2) Software that transmits safety-critical data, including time-critical data and data about hazardous conditions.

(3) Software used for fault detection in safety-critical computer hardware or software.

(4) Software that responds to the detection of a safety-critical fault.

(5) Software used in a flight safety system.

(6) Processor-interrupt software associated with previously designated safety-critical computer system functions.

(7) Software that computes safety-critical data.

(8) Software that accesses safety-critical data.

(9) Software used for wind weighting.

(c) A launch operator must conduct computing system and software hazard analyses for the integrated system.

(d) A launch operator must develop and implement computing system and software validation and verification plans.

(e) A launch operator must develop and implement software development plans, including descriptions of the following:

(1) Coding standards used;

(2) Configuration control;

(3) Programmable logic controllers;

(4) Policy on use of any commercial-off-the-shelf software; and

(5) Policy on software reuse.

### § 417.125 Launch of an unguided suborbital launch vehicle.

(a) *Applicability.* This section applies only to a launch operator conducting a launch of an unguided suborbital launch vehicle.

(b) *Need for flight safety system.* A launch operator must launch an unguided suborbital launch vehicle with a flight safety system in accordance with § 417.107 (a) and subpart D of this part unless one of the following exceptions applies:

(1) The unguided suborbital launch vehicle, including any component or payload, does not have sufficient energy to reach any populated area in any direction from the launch point; or

(2) A launch operator demonstrates through the licensing process that the launch will be conducted using a wind weighting safety system that meets the requirements of paragraph (c) of this section.

(c) *Wind weighting safety system.* A launch operator's wind weighting safety system must consist of equipment, procedures, analysis and personnel functions used to determine the launcher elevation and azimuth settings that correct for the windcocking and wind drift that an unguided suborbital launch vehicle will experience during flight due to wind effects. The launch of an unguided suborbital launch vehicle that uses a wind weighting safety system must meet the following requirements:

(1) The unguided suborbital launch vehicle must not contain a guidance or directional control system.

(2) The launcher azimuth and elevation settings must be wind weighted to correct for the effects of wind conditions at the time of flight to provide a safe impact location. A launch operator must conduct the launch in accordance with the wind weighting analysis requirements and methods of § 417.233 and appendix C of this part.

(3) A launch operator must use a launcher elevation angle setting that ensures the rocket will not fly uprange. A launch operator must set the launcher elevation angle in accordance with the following:

(i) The nominal launcher elevation angle must not exceed 85°. The wind corrected launcher elevation setting must not exceed 86°.

(ii) For an unproven unguided suborbital launch vehicle, the nominal launcher elevation angle must not exceed 80°. The wind corrected launcher elevation setting must not exceed 84°. A proven unguided suborbital launch vehicle is one that has demonstrated, by two or more launches, that flight performance errors are within all the three-sigma dispersion parameters modeled in the wind weighting safety system.

(d) *Public risk criteria.* A launch operator must conduct the launch of an unguided suborbital launch vehicle in accordance with the public risk criteria of § 417.107(b). The risk to the public determined prior to the day of flight must satisfy the public risk criteria for the area defined by the range of nominal launch azimuths. A launch operator must not initiate flight until a launch operator has verified that the wind drifted impacts of all planned impacts and their five-sigma dispersion areas satisfy the public risk criteria after wind weighting on the day of flight.

(e) *Stability.* An unguided suborbital launch vehicle, in all configurations, must be stable in flexible body to 1.5 calibers and rigid body to 2.0 calibers throughout each stage of powered flight. A caliber, for a rocket configuration, is defined as the distance between the center of pressure and the center of gravity divided by the largest frontal diameter of the rocket configuration.

(f) *Tracking.* A launch operator must track the flight of an unguided suborbital launch vehicle. The tracking system must provide data to determine the actual impact locations of all stages and components, to verify the effectiveness of a launch operator's wind weighting safety system, and to obtain rocket performance data for comparison with the preflight performance predictions.

(g) *Post-launch review.* A launch operator must ensure that the post-launch report required by § 417.25 includes:

(1) Actual impact location of all impacting stages and each impacting component.

(2) A comparison of actual and predicted nominal performance.

(3) Investigation results of any launch anomaly. If flight performance deviates by more than a three-sigma dispersion from the nominal trajectory, a launch operator must conduct an investigation to determine the cause of the rocket's deviation from normal flight and take corrective action before the next launch. A launch operator must file any corrective actions with the FAA as a request for license modification before

the next launch in accordance with § 417.11.

### § 417.127 Unique safety policies, requirements and practices.

For each launch, a launch operator must review operations, system designs, analysis, and testing, and identify any unique hazards not otherwise addressed by this part. A launch operator must implement any unique safety policy, requirement, or practice needed to protect the public from the unique hazard. A launch operator must demonstrate through the licensing process that any unique safety policy, requirement, or practice ensures the safety of the public. For any change to a unique safety policy, requirement, or practice, with the exception of a launch specific update, the launch operator must file a request for license modification as required by § 417.11. The FAA may identify and impose a unique safety policy, requirement, or practice as needed to protect the public.

### § 417.129 Safety at end of launch.

A launch operator must ensure for any proposed launch that for all launch vehicle stages or components that reach Earth orbit—

(a) There is no unplanned physical contact between the vehicle or any of its components and the payload after payload separation;

(b) Debris generation does not result from the conversion of energy sources into energy that fragments the vehicle or its components. Energy sources include chemical, pressure, and kinetic energy; and

(c) Stored energy is removed by depleting residual fuel and leaving all fuel line valves open, venting any pressurized system, leaving all batteries in a permanent discharge state, and removing any remaining source of stored energy.

### §§ 417.130 through 417.200 [Reserved]

## Subpart C—Flight Safety Analysis

### § 417.201 Scope and applicability.

(a) This subpart contains requirements for performing the flight safety analysis required by § 417.107(f).

(b) The flight safety analysis requirements of this subpart apply to the flight of any launch vehicle that must use a flight safety system as required by § 417.107(a), except as permitted by paragraph (d) of this section.

(c) The flight safety analysis requirements of §§ 417.203, 417.205, 417.207, 417.211, 417.223, 417.224, 417.225, 417.227, 417.229, 417.231, and 417.233 apply to the flight of any unguided suborbital launch vehicle that uses a wind-weighting safety system. Appendices B, C, and I of this part also apply.

(d) For any alternative flight safety system approved by the FAA under § 417.301(b), the FAA will determine during the licensing process which of the analyses required by this subpart apply.

### § 417.203 Compliance.

(a) *General.* A launch operator's flight safety analysis must satisfy the performance requirements of this subpart. The flight safety analysis must also meet the requirements for methods of analysis contained in appendices A and B of this part for a launch vehicle flown with a flight safety system and appendices B and C of this part for an unguided suborbital launch vehicle that uses a wind-weighting safety system except as otherwise permitted by this section. A flight safety analysis for a launch may rely on an earlier analysis from an identical or similar launch if the analysis still applies to the later launch.

(b) *Method of analysis.*

(1) For each launch, a launch operator's flight safety analysis must use—

(i) A method approved by the FAA during the licensing process;

(ii) A method approved as a license modification by the FAA; or,

(iii) If the launch takes place from a Federal launch range, a method approved as part of the FAA's launch site safety assessment of the Federal range's processes.

(2) Appendix A of this part contains requirements that apply to all methods of flight safety analysis. A licensee must notify the FAA for any change to the flight safety analysis method. A licensee must file any material change with the FAA as a request for license modification before the launch to which the proposed change would apply. Section 417.11 contains requirements governing a license modification.

(c) *Alternate analysis method.* The FAA will approve an alternate flight safety analysis method if a launch operator demonstrates, in accordance with § 406.3(b), that its proposed analysis method provides an equivalent level of fidelity to that required by this subpart. A launch operator must demonstrate that an alternate flight safety analysis method is based on accurate data and scientific principles and is statistically valid. The FAA will not find a launch operator's application for a license or license modification sufficiently complete to begin review under § 413.11 of this chapter until the FAA approves the alternate flight safety analysis method.

(d) *Analyses performed by a Federal launch range.* This provision applies to all sections of this subpart. The FAA will accept a flight safety analysis used by a Federal launch range without need for further demonstration of compliance to the FAA, if:

(1) A launch operator has contracted with a Federal launch range for the provision of flight safety analysis; and

(2) The FAA has assessed the Federal launch range, through its launch site safety assessment, and found that the range's analysis methods satisfy the requirements of this subpart. In this case, the FAA will treat the Federal launch range's analysis as that of a launch operator.

(e) *Analysis products.* For a licensed launch that does not satisfy paragraph (d) of this section, a launch operator must demonstrate to the FAA compliance with the requirements of this subpart, and must include in its demonstration the analysis products required by part 415 subpart F of this chapter, part 417 subpart A, and appendices A, B, C, and I of this part, depending on whether the launch vehicle uses a flight safety system or a wind-weighting safety system.

### § 417.205 General.

(a) *Public risk management.* A flight safety analysis must demonstrate that a launch operator will, for each launch, control the risk to the public from hazards associated with normal and malfunctioning launch vehicle flight. The analysis must employ risk assessment, hazard isolation, or a combination of risk assessment and partial isolation of the hazards, to demonstrate control of the risk to the public.

(1) *Risk assessment.* When demonstrating control of risk through risk assessment, the analysis must demonstrate that any risk to the public satisfies the public risk criteria of § 417.107(b). The analysis must account for the variability associated with:

(i) Each source of a hazard during flight;

(ii) Normal flight and each failure response mode of the launch vehicle;

(iii) Each external and launch vehicle flight environment;

(iv) Populations potentially exposed to the flight; and

(v) The performance of any flight safety system, including time delays associated with the system.

(2) *Hazard isolation.* When demonstrating control of risk through hazard isolation, the analysis must

establish the geographical areas from which the public must be excluded during flight and any operational controls needed to isolate all hazards from the public.

(3) *Combination of risk assessment and partial isolation of hazards.* When demonstrating control of risk through a combination of risk assessment and partial isolation of the hazards from the public, the analysis must demonstrate that the residual public risk due to any hazard not isolated from the public under paragraph (a)(2) of this section satisfies the public risk criteria of § 417.107(b).

(b) *Dependent analyses.* Because some analyses required by this subpart are inherently dependent on one another, the data output of any one analysis must be compatible in form and content with the data input requirements of any other analysis that depends on that output. Figure 417.205–1 illustrates the flight safety analyses that might be performed for a launch flown with a flight safety system and the typical dependencies that might exist among the analyses.

BILLING CODE 4910–13–P

| **Data Source Analyses**<br><br>(These analyses provide data to the dependent analyses indicated with an X.) | **Dependent Analyses**<br><br>(These analyses use data from the data source analyses indicated as input.) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Malfunction Turn | Flight Safety Limits | Straight Up Time | No-Longer Terminate Gate | Data Loss Flight Time | Flight Hazard Areas | Debris Risk Analysis | Toxic Release Hazard Analysis | Far Field Overpressure Blast Effects Analysis | |
| Trajectory Analysis | X | X | X | X | X | X | X | X | X | X |
| Malfunction Turn Analysis | | X | X | | X | X | X | X | X | |
| Debris Analysis | | X | X | X | X | X | X | X | X | X |
| Flight Safety Limits | | | X | X | X | X | X | X | X | |
| Straight-Up Time | | | | | | | | X | X | |
| Planned Safe Flight State | | | | | X | | X | X | X | |
| Data Loss Flight Time | X | | | | | | | | | |
| Time-Delay Analysis | X | X | X | X | X | X | X | X | X | X |

Figure 417.205-1, Illustration of dependent flight safety analyses that might be performed for a launch that uses a flight safety system

BILLING CODE 4910–13–C

### § 417.207 Trajectory analysis.

(a) *General.* A flight safety analysis must include a trajectory analysis that establishes:

(1) For any time after lift-off, the limits of a launch vehicle's normal flight, as defined by the nominal trajectory and potential three-sigma trajectory dispersions about the nominal trajectory.

(2) A fuel exhaustion trajectory that produces instantaneous impact points with the greatest range for any given time after liftoff for any stage that has the potential to impact the Earth and does not burn to propellant depletion before a programmed thrust termination.

(3) For launch vehicles flown with a flight safety system, a straight-up trajectory for any time after lift-off until the straight-up time that would result if the launch vehicle malfunctioned and flew in a vertical or near vertical direction above the launch point.

(b) *Trajectory model.* A final trajectory analysis must use a six-degree of freedom trajectory model to satisfy the requirements of paragraph (a) of this section.

(c) *Wind effects.* A trajectory analysis must account for all wind effects, including profiles of winds that are no less severe than the worst wind conditions under which flight might be attempted, and must account for uncertainty in the wind conditions.

### § 417.209 Malfunction turn analysis.

(a) *General.* A flight safety analysis must include a malfunction turn analysis that establishes the launch vehicle's turning capability in the event of a malfunction during flight. A malfunction turn analysis must account for each cause of a malfunction turn, such as thrust vector offsets or nozzle burn-through. For each cause of a malfunction turn, the analysis must establish the launch vehicle's turning capability using a set of turn curves. The analysis must account for:

(1) All trajectory times during the thrusting phases of flight.

(2) When a malfunction begins to cause each turn throughout the thrusting phases of flight. The analysis must account for trajectory time intervals between malfunction turn start times that are sufficient to establish flight safety limits and hazard areas that are smooth and continuous.

(3) The relative probability of occurrence of each malfunction turn of which the launch vehicle is capable.

(4) The time, as a single value or a probability time distribution, when each malfunction turn will terminate due to vehicle breakup.

(5) What terminates each malfunction turn, such as, aerodynamic breakup or inertial breakup.

(6) The launch vehicle's turning behavior from the time when a malfunction begins to cause a turn until aerodynamic breakup, inertial breakup, or ground impact. The analysis must account for trajectory time intervals during the malfunction turn that are sufficient to establish turn curves that are smooth and continuous.

(7) For each malfunction turn, the launch vehicle velocity vector turn angle from the nominal launch vehicle velocity vector.

(8) For each malfunction turn, the launch vehicle velocity turn magnitude from the nominal velocity magnitude that corresponds to the velocity vector turn angle.

(9) For each malfunction turn, the orientation of the launch vehicle longitudinal axis measured relative to the nominal launch vehicle longitudinal axis or Earth relative velocity vector at the start of the turn.

(b) *Set of turn curves for each malfunction turn cause.* For each cause of a malfunction turn, the analysis must establish a set of turn curves that satisfies paragraph (a) of this section and must establish the associated envelope of the set of turn curves. Each set of turn curves must describe the variation in the malfunction turn characteristics for each cause of a turn. The envelope of each set of curves must define the limits of the launch vehicle's malfunction turn behavior for each cause of a malfunction turn. For each malfunction turn envelope, the analysis must establish the launch vehicle velocity vector turn angle from the nominal launch vehicle velocity vector. For each malfunction turn envelope, the analysis must establish the vehicle velocity turn magnitude from the nominal velocity magnitude that corresponds to the velocity vector turn angle envelope.

### § 417.211 Debris analysis.

(a) *General.* A flight safety analysis must include a debris analysis. For an orbital or suborbital launch, a debris analysis must identify the inert, explosive, and other hazardous launch vehicle debris that results from normal and malfunctioning launch vehicle flight.

(b) *Launch vehicle breakup.* A debris analysis must account for each cause of launch vehicle breakup, including at a minimum:

(1) Any flight termination system activation;

(2) Launch vehicle explosion;

(3) Aerodynamic loads;

(4) Inertial loads;

(5) Atmospheric reentry heating; and

(6) Impact of intact vehicle.

(c) *Debris fragment lists.* A debris analysis must produce lists of debris fragments for each cause of breakup and any planned jettison of debris, launch vehicle components, or payload. The lists must account for all launch vehicle debris fragments, individually or in groupings of fragments whose characteristics are similar enough to be described by a single set of characteristics. The debris lists must describe the physical, aerodynamic, and harmful characteristics of each debris fragment, including at a minimum:

(1) Origin on the vehicle, by vehicle stage or component, from which each fragment originated;

(2) Whether it is inert or explosive;

(3) Weight, dimensions, and shape;

(4) Lift and drag characteristics;

(5) Properties of the incremental velocity distribution imparted by breakup; and

(6) Axial, transverse, and tumbling area.

### § 417.213 Flight safety limits analysis.

(a) *General.* A flight safety analysis must identify the location of populated or other protected areas, and establish flight safety limits that define when a flight safety system must terminate a launch vehicle's flight to prevent the hazardous effects of the resulting debris impacts from reaching any populated or other protected area and ensure that the launch satisfies the public risk criteria of § 417.107(b).

(b) *Flight safety limits.* The analysis must establish flight safety limits for use in establishing flight termination rules. Section 417.113(c) contains requirements for flight termination rules. The flight safety limits must account for all temporal and geometric extents on the Earth's surface of a launch vehicle's hazardous debris impact dispersion resulting from any planned or unplanned event for all times during flight. Flight safety limits must account for all potential contributions to the debris impact dispersions, including at a minimum:

(1) All time delays, as established by the time delay analysis of § 417.221;

(2) Residual thrust remaining after flight termination implementation or vehicle breakup due to aerodynamic and inertial loads;

(3) All wind effects;

(4) Velocity imparted to vehicle fragments by breakup;

(5) All lift and drag forces on the malfunctioning vehicle and falling debris;

(6) All launch vehicle guidance and performance errors;

(7) All launch vehicle malfunction turn capabilities; and

(8) Any uncertainty due to map errors and launch vehicle tracking errors.

(c) *Gates.* If a launch involves flight over any populated or other protected area, the flight safety analysis must establish a gate as required by §§ 417.217 and 417.218.

(d) *Designated debris impact limits.* The analysis must establish designated impact limit lines to bound the area where debris with a ballistic coefficient of three or more is allowed to impact if the flight safety system functions properly.

### § 417.215 Straight-up time analysis.

A flight safety analysis must establish the straight-up time for a launch for use as a flight termination rule. Section 417.113(c) contains requirements for flight termination rules. The analysis must establish the straight-up time as the latest time after liftoff, assuming a launch vehicle malfunctioned and flew in a vertical or near vertical direction above the launch point, at which activation of the launch vehicle's flight termination system or breakup of the launch vehicle would not cause hazardous debris or critical overpressure to affect any populated or other protected area.

### § 417.217 Overflight gate analysis.

For a launch that involves flight over a populated or other protected area, the flight safety analysis must include an overflight gate analysis. The analysis must establish the portion of a flight safety limit, a gate, through which a normally performing launch vehicle's tracking icon will be allowed to proceed. A tracking icon must enable the flight safety crew to determine whether the launch vehicle's flight is in compliance with the flight safety rules established under § 417.113. When establishing that portion of a flight safety limit, the analysis must demonstrate that the launch vehicle flight satisfies the flight safety requirements of § 417.107.

### § 417.218 Hold-and-resume gate analysis.

(a) For a launch that involves overflight or near overflight of a populated or otherwise protected area prior to the planned safe flight state calculated as required by § 417.219, the flight safety analysis must construct a hold-and-resume gate for each populated or otherwise protected area. After a vehicle's tracking icon crosses a hold-and-resume gate, flight termination must occur as required by sections 417.113(d)(6).

(b) The hold-and-resume gate analysis must account for:

(1) *Overflight of a wholly contained populated or otherwise protected area.* A hold-and-resume gate must be a closed, continuous contour that encompasses any populated or otherwise protected area located wholly within the impact limit lines. The hold-and-resume gate must encompass a populated or otherwise protected area such that flight termination or breakup of the launch vehicle while the tracking icon is outside the gate would not cause hazardous debris or overpressure to endanger the populated or otherwise protected area.

(2) *Overflight of an uncontained populated or otherwise protected area.* A hold-and-resume gate must be a closed, continuous contour that encompasses any area in which flight termination is allowed to occur. The hold-and-resume gate must encompass all hazard areas such that flight termination or breakup of the launch vehicle while the vehicle's tracking icon is inside the gate would not cause hazardous debris or critical overpressure to endanger any populated or otherwise protected area.

### § 417.219 Data loss flight time and planned safe flight state analyses.

(a) *General.* For each launch, a flight safety analysis must establish data loss flight times, as identified by paragraph (b) of this section, and a planned safe flight state to establish each flight termination rule that applies when launch vehicle tracking data is not available for use by the flight safety crew. Section 417.113(d) contains requirements for flight termination rules.

(b) *Data loss flight times.* A flight safety analysis must establish the shortest elapsed thrusting time during which a launch vehicle can move from normal flight to a condition where the launch vehicle's hazardous debris impact dispersion extends to any protected area as a data loss flight time. The analysis must establish a data loss flight time for all times along the nominal trajectory from liftoff through that point during nominal flight when the minimum elapsed thrusting time is no greater than the time it would take for a normal vehicle to reach the overflight gate, or the planned safe flight state established under paragraph (c) of this section, whichever occurs earlier.

(c) *Planned safe flight state.* For a launch vehicle that performs normally during all portions of flight, the planned safe flight state is the point during the nominal flight of a launch vehicle where:

(1) No launch vehicle component, debris, or hazard can impact or affect a populated or otherwise protected area for the remainder of the launch;

(2) The launch vehicle achieves orbital insertion; or

(3) The launch vehicle's state vector reaches a state where the absence of a flight safety system would not significantly increase the accumulated risk from debris impacts and maintains positive flight safety system control to the maximum extent feasible.

### § 417.221 Time delay analysis.

(a) *General.* A flight safety analysis must include a time delay analysis that establishes the mean elapsed time between the violation of a flight termination rule and the time when the flight safety system is capable of terminating flight for use in establishing flight safety limits as required by § 417.213.

(b) *Analysis constraints.* A time delay analyses must determine a time delay distribution that accounts for the following:

(1) The variance of all time delays for each potential failure scenario, including but not limited to, the range of malfunction turn characteristics and the time of flight when the malfunction occurs;

(2) A flight safety official's decision and reaction time, including variation in human response time; and

(3) Flight termination hardware and software delays including all delays inherent in:

(i) Tracking systems;

(ii) Data processing systems, including all filter delays;

(iii) Display systems;

(iv) Command control systems; and

(v) Flight termination systems.

### § 417.223 Flight hazard area analysis.

(a) *General.* A flight safety analysis must include a flight hazard area analysis that identifies any regions of land, sea, or air that must be surveyed, publicized, controlled, or evacuated in order to control the risk to the public from debris impact hazards. The risk management requirements of § 417.205(a) apply. The analysis must account for, at a minimum:

(1) All trajectory times from liftoff to the planned safe flight state of § 417.219(c), including each planned impact, for an orbital launch, and through final impact for a suborbital launch;

(2) Regions of land potentially exposed to debris resulting from normal flight events and events resulting from any potential malfunction;

(3) Regions of sea and air potentially exposed to debris from normal flight events, including planned impacts;

(4) In the vicinity of the launch site, any waterborne vessels, populated offshore structures, or aircraft exposed to debris from events resulting from any potential abnormal flight events, including launch vehicle malfunction;

(5) Any operational controls implemented to control risk to the public from debris hazards;

(6) Debris identified by the debris analysis of § 417.211; and

(7) All launch vehicle trajectory dispersion effects in the surface impact domain.

(b) Public notices. A flight hazard areas analysis must establish the ship hazard areas for notices to mariners that encompass the three-sigma impact dispersion area for each planned debris impact. A flight hazard areas analysis must establish the aircraft hazard areas for notices to airmen that encompass the 3-sigma impact dispersion volume for each planned debris impact. Section 417.121(e) contains procedural requirements for issuing notices to mariners and airmen.

### § 417.224 Probability of failure analysis.

(a) *General.* All flight safety analyses for a launch, regardless of hazard or phase of flight, must account for launch vehicle failure probability in a consistent manner. A launch vehicle failure probability estimate must use accurate data, scientific principles, and a method that is statistically or probabilistically valid. For a launch vehicle with fewer than two flights, the failure probability estimate must account for the outcome of all previous launches of vehicles developed and launched in similar circumstances. For a launch vehicle with two or more flights, launch vehicle failure probability estimates must account for the outcomes of all previous flights of the vehicle in a statistically valid manner.

(b) *Failure.* For flight safety analysis purposes, a failure occurs when a launch vehicle does not complete any phase of normal flight or when any anomalous condition exhibits the potential for a stage or its debris to impact the Earth or reenter the atmosphere during the mission or any future mission of similar launch vehicle capability. Also, either a launch incident or launch accident constitutes a failure.

(c) *Previous flight.* For flight analysis purposes, flight begins at a time in which a launch vehicle normally or inadvertently lifts off from a launch platform. Lift-off occurs with any motion of the launch vehicle with respect to the launch platform.

### § 417.225 Debris risk analysis.

A flight safety analysis must demonstrate that the risk to the public potentially exposed to inert and explosive debris hazards from any one flight of a launch vehicle satisfies the public risk criterion of § 417.107(b) for debris. A debris risk analysis must account for risk to populations on land, including regions of launch vehicle flight following passage through any gate in a flight safety limit established as required by § 417.217. A debris risk analysis must account for any potential casualties to the public as required by the debris thresholds and requirements of § 417.107(c).

### § 417.227 Toxic release hazard analysis.

A flight safety analysis must establish flight commit criteria that protect the public from any hazard associated with toxic release and demonstrate compliance with the public risk criterion of § 417.107(b). The analysis must account for any toxic release that will occur during the proposed flight of a launch vehicle or that would occur in the event of a flight mishap. The analysis must account for any operational constraints and emergency procedures that provide protection from toxic release. The analysis must account for all members of the public that may be exposed to the toxic release, including all members of the public on land and on any waterborne vessels, populated offshore structures, and aircraft that are not operated in direct support of the launch.

### § 417.229 Far-field overpressure blast effects analysis.

(a) *General.* A flight safety analysis must establish flight commit criteria that protect the public from any hazard associated with far field blast overpressure effects due to potential explosions during launch vehicle flight and demonstrate compliance with the public risk criterion of § 417.107(b).

(b) *Analysis constraints.* The analysis must account for:

(1) The potential for distant focus overpressure or overpressure enhancement given current meteorological conditions and terrain characteristics;

(2) The potential for broken windows due to peak incident overpressures below 1.0 psi and related casualties;

(3) The explosive capability of the launch vehicle at impact and at altitude and potential explosions resulting from debris impacts, including the potential for mixing of liquid propellants;

(4) Characteristics of the launch vehicle flight and the surroundings that would affect the population's susceptibility to injury, such as, shelter types and time of day of the proposed launch;

(5) Characteristics of the potentially affected windows, including their size, location, orientation, glazing material, and condition; and

(6) The hazard characteristics of the potential glass shards, such as falling from upper building stories or being propelled into or out of a shelter toward potentially occupied spaces.

### § 417.231 Collision avoidance analysis.

(a) *General.* A flight safety analysis must include a collision avoidance analysis that establishes each launch wait in a planned launch window during which a launch operator must not initiate flight, in order to protect any maned or mannable orbiting object. A launch operator must account for uncertainties associated with launch vehicle performance and timing and ensure that any calculated launch waits incorporate all additional time periods associated with such uncertainties. A launch operator must implement any launch waits as flight commit criteria according to § 417.113(b).

(b) *Orbital launch.* For an orbital launch, the analysis must establish any launch waits needed to ensure that the launch vehicle, any jettisoned components, and its payload do not pass closer than 200 kilometers to a manned or mannable orbiting object during ascent to initial orbital insertion through at least one complete orbit.

(c) *Suborbital launch.* For a suborbital launch, the analysis must establish any launch waits needed to ensure that the launch vehicle, any jettisoned components, and any payload do not pass closer than 200 kilometers to a manned or mannable orbital object throughout the flight.

(d) *Analysis not required.* A collision avoidance analysis is not required if the maximum altitude attainable by a launch operator's unguided suborbital launch vehicle is less than the altitude of the lowest manned or mannable orbiting object. The maximum altitude attainable must be obtained using an optimized trajectory, assuming 3-sigma maximum performance.

### § 417.233 Analysis for an unguided suborbital launch vehicle flown with a wind weighting safety system.

For each launch of an unguided suborbital launch vehicle flown with a

wind weighting safety system, in addition to the other requirements in this subpart outlined in § 417.201(c), the flight safety analysis must:

(a) Establish flight commit criteria and other launch safety rules that a launch operator must implement to control the risk to the public from potential adverse effects resulting from normal and malfunctioning flight;

(b) Establish any wind constraints under which launch may occur; and

(c) Include a wind weighting analysis that establishes the launcher azimuth and elevation settings that correct for the windcocking and wind-drift effects on the unguided suborbital launch vehicle.

## Subpart D—Flight Safety System

### § 417.301 General.

(a) *Applicability.* This subpart applies to any flight safety system that a launch operator uses. The requirements of § 417.107(a) define when a launch operator must use a flight safety system. A launch operator must ensure that its flight safety system satisfies all the requirements of this subpart, including the referenced appendices. Paragraph (b) of this section provides an exception to this.

(b) *Alternate flight safety system.* A flight safety system need not satisfy one or more of the requirements of this subpart for a launch if a launch operator demonstrates, in accordance with § 406.3(b), that the launch achieves an equivalent level of safety as a launch that satisfies all the requirements of this part. The flight safety system must undergo analysis and testing that is comparable to that required by this part to demonstrate that the system's reliability to perform each intended function is comparable to that required by this subpart.

(c) *Functions, subsystems, and components.* When initiated in the event of a launch vehicle failure, a flight safety system must prevent any launch vehicle hazard, including any payload hazard, from reaching a populated or other protected area. A flight safety system must consist of all of the following:

(1) A flight termination system that satisfies appendices D, E, and F of this part;

(2) A command control system that satisfies §§ 417.303 and 417.305;

(3) Each support system required by § 417.307; and

(4) The functions of any personnel who operate flight safety system hardware or software including a flight safety crew that satisfies § 417.311.

(d) *Compliance.*

(1) *Non-Federal launch site.* For launch from a non-Federal launch site, any flight safety system, including all components, must:

(i) Comply with a launch operator's flight safety system compliance matrix of § 415.127(g) that accounts for all the design, installation, and monitoring requirements of this subpart, including the referenced appendices; and

(ii) Comply with a launch operator's testing compliance matrix of § 415.129(b) that accounts for all the test requirements of this subpart, including the referenced appendices.

(2) *Federal launch range.* This provision applies to all sections of this subpart. The FAA will accept a flight safety system used or approved on a Federal launch range without need for further demonstration of compliance to the FAA if:

(i) A launch operator has contracted with a Federal launch range for the provision of flight safety system property and services; and

(ii) The FAA has assessed the Federal launch range, through its launch site safety assessment, and found that the Federal launch range's flight safety system property and services satisfy the requirements of this subpart. In this case, the FAA will treat the Federal launch range's flight safety system property and services as that of a launch operator.

### § 417.303 Command control system requirements.

(a) *General.* When initiated by a flight safety official, a command control system must transmit a command signal that has the radio frequency characteristics and power needed for receipt of the signal by the onboard vehicle flight termination system. A command control system must include all of the following:

(1) All flight termination system activation switches;

(2) All intermediate equipment, linkages, and software;

(3) Any auxiliary stations;

(4) Each command transmitter and transmitting antenna; and

(5) All support equipment that is critical for reliable operation, such as power, communications, and air conditioning systems.

(b) *Performance specifications.* A command control system and each subsystem, component, and part that can affect the reliability of a component must have written performance specifications that demonstrate, and contain the details of, how each satisfies the requirements of this section.

(c) *Reliability prediction.* A command control system must have a predicted reliability of 0.999 at the 95 percent confidence level when operating, starting with completion of the preflight testing and system verification of § 417.305(c) through initiation of flight and until the planned safe flight state for each launch. Any demonstration of the system's predicted reliability must satisfy § 417.309(b).

(d) *Fault tolerance.* A command control system must not contain any single-failure-point that, upon failure, would inhibit the required functioning of the system or cause the transmission of an undesired flight termination message. A command control system's design must ensure that the probability of transmitting an undesired or inadvertent command during flight is less than $1 \times 10^{-7}$.

(e) *Configuration control.* A command control system must undergo configuration control to ensure its reliability and compatibility with the flight termination system used for each launch.

(f) *Electromagnetic interference.* Each command control system component must function within the electromagnetic environment to which it is exposed. A command control system must include protection to prevent interference from inhibiting the required functioning of the system or causing the transmission of an undesired or inadvertent flight termination command. Any susceptible remote control data processing or transmitting system that is part of the command control system must prevent electromagnetic interference.

(g) *Command transmitter failover.* A command control system must include independent, redundant transmitter systems that automatically switch, or ''fail-over,'' from a primary transmitter to a secondary transmitter when a condition exists that indicates potential failure of the primary transmitter. The switch must be automatic and provide all the same command control system capabilities through the secondary transmitter system. The secondary transmitter system must respond to any transmitter system configuration and radio message orders established for the launch. The fail-over criteria that trigger automatic switching from the primary transmitter to the secondary transmitter must account for each of the following transmitter performance parameters and failure indicators:

(1) Low transmitter power;

(2) Center frequency shift;

(3) Out of tolerance tone frequency;

(4) Out of tolerance message timing;

(5) Loss of communication between central control and transmitter site;